NATURE

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CONTENTS

	PAGE
Retrospect and Prospect. By Sir Richard Gregory, Bart., F.R.S.	1
Science for Africa. By Major A. G. Church	2
An Anthology of Anthropology	5
Science and the Chemical Industry	6
Cancer: Radiological Treatment and Research. By Prof. S. Russ, C.B.E.	9
Scientific Centenaries in 1939. By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.	10
Potato Problems. By Dr. S. Linné	12
News and Views	16
Letters to the Editor:	
Estimation of Vitamin A.—Miss E. M. Hume	22
A Rapid Visual Test for Vitamin A Deficiency.—Dr. L. B. Pett	23
Laccase, a Blue Copper-Protein Oxidase from the Latex of *Rhus succedanea*.—Prof. D. Keilin, F.R.S., and Dr. T. Mann	23
The Sympathetic Character of the Nucleus Supraopticus.—Mervyn Griffiths	24
Heteroauxin Production by Efficient and Inefficient Strains of *Rhizobia*.—Dr. Carl E. Georgi and Albert E. Beguin	25
Fossil Man-Apes of South Africa.—Prof. William K. Gregory and Dr. Milo Hellman	25
Effect of an Electric Field on the Viscosity of Liquids.—Prof. E. N. da C. Andrade, F.R.S., and C. Dodd	26
Fundamental Vibration of a Rectangular Plate.—Miss Mary D. Waller	27
Relation between Specific Heat and Temperature for Nitrobenzene.—Dr. J. Mazur	28
After-Image Phenomena.—Dr. F. Edridge-Green, C.B.E.	28
Ultra-Violet Spectrum of Thiophosgene.—Prof. Victor Henri and Dr. Jules Duchesne	28
Research Items	30
Scattering of Wireless Waves in the Ionosphere. By T. L. Eckersley, F.R.S.	33
Structure of Proteins	34
Studies in Galactic Structure	35
Education for Citizenship	35
The Differential Analyser in Electrical Engineering	36
Electric Power Supply in India	37
Science News a Century Ago	37
University Events	38
Societies and Academies	38

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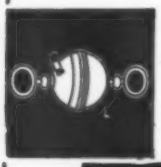

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Retrospect and Prospect

THE public announcement of my retirement from the editorship of NATURE was made only a few days before my departure for the United States to deliver the Elihu Root Lecture at the Carnegie Institution of Washington on December 8, and to give a few other addresses at universities, as well as at the Richmond meeting of the American Association, on social and international aspects of science. Before leaving England, it was not possible for me to thank more than a few of my personal and other friends for their kind messages, but to them, and to all who have helped me with contributions and advice during the forty-five years of my association with NATURE, first as assistant editor to Sir Norman Lockyer, and later as editor, I welcome the opportunity now given me of expressing my very grateful appreciation of their interest and aid.

Throughout its existence, NATURE has had the active support of leading workers in scientific fields in many parts of the world. The aim has always been to record results of research of wide interest or particular importance wherever it has been carried out, and to present authoritative thought and opinion upon progressive scientific developments and their influence. In the early years of the journal, there was little recognition of the practical services which science can render to industry, or of the place which it should occupy in a modern State. Appeals for endowment of scientific research were perversely described as implying the search of scientific workers themselves for endowment in privileged positions rather than as a means of promoting intellectual and industrial progress. Much still remains to be done before our statesmen and industrial leaders are fully aware of the power which science can give to the community, both socially and materially, yet the general principle that expenditure on research is a profitable investment may be said to have been conceded.

Forty-five years ago, the annual grants of the British Government for scientific investigation and related subjects, as shown in the Civil Estimates, were about £45,000. At the present time, they amount to nearly £2,000,000, of which the Department of Scientific and Industrial Research administers about £700,000. Less than one quarter of the net expenditure of the Department represents, however, grants for purposes directly or indirectly connected with industry; and the actual annual economies introduced into industries as the result of research have a financial value many times greater than the amounts expended upon them. On the most generous estimate, the grants for direct and indirect support of scientific research in Great Britain, including those expended in departments of armed forces, represent only one tenth of one per cent of the national income. While, therefore, it is gratifying to be able to record that the policy of State endowment of scientific research consistently advocated in NATURE has been accepted, industrial and social conditions are now changing so rapidly that a much bolder and broader financial scheme will have to be undertaken if the advancing front of

knowledge is to be made available for wise planning and efficient action in times of peace or of war.

Even, however, when adequate provision has been made for scientific research in biological as well as physical fields, whether purely with the object of increasing natural knowledge or for the purpose of industrial development, scientific workers will neglect their special responsibilities as citizens if they are indifferent to the social consequences of their discoveries. To the enlightened public, science signifies the disinterested pursuit of truth by patient observation, critical inquiry, unprejudiced examination of evidence and convincing judgment; but there are still many people who associate it with the conversion of pleasant natural scenes into industrial slums and with clouds of poison gas and other barbarous means of destroying man and his noblest works. It is the duty of scientific workers on one hand to do nothing which would shake the confidence of the community in the principles for which they stand, and on the other to take every opportunity to absolve themselves of responsibility for the prostitution of the gifts with which they endow the human race. It would be a betrayal of the scientific movement if those who represent it failed to play an active part in solving the social problems which their contributions to natural knowledge have created.

It is with such social and international relationships of science that NATURE has been largely concerned during the past twenty years or so; and the recent formation of the new Division of the British Association, as well as the steps taken by the American Association and similar organizations of scientific workers to make their promotion a common cause, represent the beginning of an international movement which may save the world from the disasters now threatening it.

The correspondence columns of NATURE have become an international clearing-house of contributions to natural knowledge; and in this field the standard of value is independent of race or nationality or any other measure than originality and scientific worth. Liberty of thought and action are essential for creative scientific work; and progress is impossible when restrictions are placed upon them.

These principles of scientific freedom have been won through generations of struggle with Church and State, and when science neglects to assert them as fundamental conditions of creative work it will commit suicide. The policy of NATURE is to establish these rights not only in the interests of scientific workers themselves but also in those of the whole community. My particular mission has been to make men of science conscious of their power and influence in shaping civilized life, and I am happy to know that my successors will continue to proclaim this message as an inspiring intellectual stimulus and a means of promoting the welfare and the brotherhood of the human race.

R. A. GREGORY.

Science for Africa

An African Survey:
a Study of Problems arising in Africa south of the Sahara. By Lord Hailey. (Issued by the Committee of the African Research Survey under the auspices of the Royal Institute of International Affairs.) Pp. xxviii+1838. (London, New York and Toronto: Oxford University Press, 1938.) 21*s.* net.

FOLLOWING an appeal for a comprehensive survey of Africa and its problems made by General Smuts in his Rhodes Memorial Lecture in 1929, an authoritative committee was formed to give effect to his proposal. Thanks to the generosity and vision of the Carnegie Corporation of New York, funds were made available, and Lord Hailey agreed to undertake the task on his retirement from the governorship of the United Provinces in India. Five years intensive work has produced a comparative study of the countries, peoples and their indigenous institutions and the influence of the different European Colonial Powers on the development of both in connexion with the exploitation of the natural resources of the whole of the mainland of Africa lying south of the Sahara, with the exception of the Anglo-Egyptian Sudan, the Italian possessions and Liberia. The survey therefore covers an area in which a Dominion of the British Commonwealth, Great Britain, France, Belgium and Portugal "are engaged in a common task, though in some respects with widely different methods of approach".

"The sole object for undertaking the Survey", says Lord Hailey, "was the hope that it might prove of some service to the Powers which have possession of territories in Africa, and of some

benefit to the African people". Understatement and humility could go no further.

In reality, the survey was conceived on a grand scale and has been compiled with imaginative insight and rare judgment. It takes into account every important aspect of the African scene. It is no mere compilation of facts, but a study in breadth and depth enriched by the intuitive and persevering genius of the master mind responsible for its direction and shape and the actual material it contains. To quote its author, "it is not limited to a discussion of the state of our knowledge regarding the problems which are involved in the development of Africa; it attempts also to describe the physical and social background out of which these problems have arisen and to analyse the factors which . . . must determine their solution". Where there are gaps, and they are not obvious, they must be attributed, not to the author and his collaborators, but to those administrations in Africa which, either deliberately or through lack of system, have not made available to the public essential information concerning their activities and problems.

The survey will commend itself to scientific workers because of its freedom from dogmatism, bias, cant or censoriousness. It will make a special appeal to those who have imbibed the spirit of the 'scientific humanism' which has been conjured up by our post-War perplexities. Some years ago, Mr. H. G. Wells expressed the opinion that the only duty of science was exact statement; its only service, truth. We have added to these the responsibility for attempting to ensure that the results of science shall be properly applied. Lord Hailey's great work satisfies all three criteria. This is his approach: "Africa presents itself as a living laboratory, in which the reward of study may prove to be not merely the satisfaction of an intellectual impulse, but an effective addition to the welfare of a people. A scientific approach to the questions of African development demands the study of problems of a social nature equally with those involving the application of the physical sciences. . . . No one question can be studied in isolation. There is close interdependence among all the essential problems of Africa".

The point needs no emphasis that Africa is undergoing a transformation rather than a development along evolutionary lines. Its impact with Western civilization has been so sudden and in many territories so catastrophic that the social and economic institutions which the different tribes have evolved through the centuries have in every case been seriously undermined. Administrations and Christian missions, often from the highest motives, have compelled changes in African social customs and habits, the results of which have been demoralization rather than the regeneration of the peoples it was hoped to benefit. We have interfered with their marriage customs, their methods of cultivation, their systems of land tenure, their tribal methods of combating disease, their ideas of crime and punishment. In fact, we have attempted to impose on them by decree an entirely new set of values without making adequate provision for the education services which would enable them to understand and appreciate the changes forced on them.

It is now more generally appreciated by the European peoples with colonial possessions that a closer study of the social institutions of the subject races, with the object of attuning our systems of administration to what is valuable in Africa itself, will make the task of development easier and not necessarily slower. The view taken in this survey is that the social conceptions and practices of Africans are the result of a natural process of accommodation to their economic and physical environment. Their social conceptions do not necessarily indicate, what certain subjective investigators would have us believe, that there is any intrinsic difference of character or mental capacity between them and other peoples. A great deal more research is needed on the educability of the African before we can dogmatize on his inherent mental inferiority to the average European or Asiatic.

Take another assumption. The belief was widely held until recently that the relative low density of population in Africa was due to native customs, inter-tribal warfare and the ravages of the slave-trade. In the light of the researches of Orr, Keeble and others on the problems of nutrition it would now seem more probable, however, that the comparatively small population of Africa can be attributed to mineral deficiencies of the soil and other physical characteristics, which militate against the maintenance of dense populations as well as increase their susceptibility, due to malnutrition, to a variety of diseases. If this be the case—and it is certainly a more satisfactory explanation than any other which has been put forward—and if Africa is to be made capable of maintaining a large settled population, remedies must be found. These must be sought for by a more intensive investigation by African Governments of the interrelated problems of anthropology, agriculture, animal husbandry, water supply and health.

Lord Hailey emphasizes other points in connexion with population. In the last hundred years, the estimates given of the population of Africa have varied from 28,000,000 to 205,000,000, based on various methods of computation. Present-day experts give the population as lying between 138,100,000 and 163,300,000, "a fact which affords

an indication of the value which scientific opinion attaches to the systems of enumeration now in use". The discrepancy is so great that it is obviously impossible to state with any assumption of truth whether the population is declining, stationary or increasing. It is just as obvious that statements made with regard to the effect of certain customs on birth-rate and mortality, or the effect of migration of labourers to the mines and other large centres of gainful occupation on population, lack the validity which could be attached to them were accurate vital statistics available.

Students of African problems will find the chapters on political and social objectives, systems of government, law and justice, and native administration a mine of information. There is no other publication where these matters have been dealt with so comprehensively or with such complete objectivity. The problem inherent in the application of the British system of indirect rule to territories where there is a large and powerful white minority, as in Southern Rhodesia, or a small, semi-aristocratic and extremely vocal white settler community, as in Kenya, is clearly outlined. We are shown, too, how the task of French administrators has been none too simple in applying the logic of their own policy of 'Frenchification' to tribes at various stages of development. French critics of British colonial policy assert that while our interest in colonial issues is genuine and well-informed, our policy is characterized by its deficiency in definition of objective and of the method of approach to our problems. They regard our policy as "a series of improvisations which depend for success not on a logical outlook, but on the exercise of a traditional skill in accommodating principles to circumstances". It is interesting to note that the French are now in the process, at least in some of their territories, of reconciling their expedients to their logic. Nevertheless, there is one matter in which the French and the Belgians appear to have been more successful than the British. So far, we have kept too many minor administrative posts for highly-paid British personnel. We have neither been successful in training Africans, nor in recruiting a type of British subordinate official, for routine duties. The consequence is that "British officers appear to be unduly occupied with routine work", due largely to the lack of any clear policy as to the extent or manner of the employment of educated Africans in the administrative or technical services.

The chapters on law and justice, land and agriculture and animal husbandry are all illustrative of the effects of European conceptions and practices upon peoples with entirely different sets of values based on fundamental differences of outlook and environment. This has resulted in a good deal of confusion, a great deal of friction and the loss of much that was valuable in African customary practice. On all three subjects, Lord Hailey pleads for considerably more research. If native customary law is to adjust itself to meet the needs of advancing society, students of jurisprudence must make a comprehensive study of African law and justice and attempt to evolve a system of law which will combine the best elements of African with those conceptions of European law which are calculated to evoke the greatest measure of agreement from the Africans themselves. Again, the question of legal titles to land is intimately connected with the methods of agriculture of different tribes, their attitude to domestic stock and their migratory customs. We still know too little to dogmatize on any of these subjects. Our interference with the method of shifting cultivation practised by many tribes led, for example, to pressure on the soil in fixed areas, with the result that the necessary period of regeneration was curtailed and the vegetal cover destroyed, the precursor to soil erosion.

In his penultimate chapter, on "The Future of African Studies", Lord Hailey pleads for the creation of two British bodies, the first, an official body charged with the central directions of research, the second, a voluntary bureau of information. The need for the first is due to the lack of direction in certain branches of research work and inevitable duplication of effort owing to the variety of authorities dealing with African problems. Lord Hailey gives full praise for the research work being done in the different African territories, by the tropical research stations, the Imperial Bureaux and the workers commissioned by the special committees of the Economic Advisory Council of the Cabinet, but suggests that a large fund should be created, preferably in the form of a non-lapsing grant-in-aid, under the administration of a committee of the Privy Council or the Economic Advisory Council, whose duty it would be to devise, in association with the appropriate scientific authorities, "the measures for making the most profitable use of the agencies concerned in any one branch of study, be it anthropology, medicine, or agriculture, and for maintaining the necessary contact between them and the agencies concerned with kindred branches of work". Such a committee, he thinks, would be effective in creating a greater interest in, and securing a larger measure of co-operation of, the universities in the solution of African problems, as well as a greater measure of co-operation between Great Britain and other colonial Powers.

Lord Hailey considers that the furtherance of research is the most important contribution Great Britain has to make to Africa at this critical stage

in its development. Unless I mistake him, he is of opinion that money devoted to research must be regarded as in the nature of a capital investment, more important than capital invested in railways and other public utility undertakings. "Errors now made for lack of knowledge which a well-considered [and generous] scheme of special study might supply may well create situations which the future can rectify only at the cost of great effort and much human distress". Every year which passes threatens to rob the effort of investigators of its value, "since conditions are likely to develop which make it progressively more difficult to apply the results of investigation and experiment".

As regards the second and voluntary body, Lord Hailey suggests that a means is required for making information concerning Africa more readily available. The present sources of information are very scattered, difficult of access and there is also difficulty in obtaining readily all the information required by those who take an interest in the economic or scientific aspects of African development. The Bureau which he envisages would act as a source of information on practically every aspect of activity in Africa, a convenient body to maintain close contact with institutions and voluntary organizations in Great Britain and other countries interested in Africa, and to provide guidance to those who seek to pursue a special study in any subject of interest in Africa. It would publish periodically a survey of contributions made to knowledge of the continent, and generally act as a clearing-house of information and form a common meeting-ground where personal contact could be established between those who desired to improve their knowledge of African affairs.

Enough has been said, it is hoped, to indicate the remarkable quality of this eagerly awaited publication. There is no important problem in connexion with Africa to which new interest has not been given. It is the most brilliantly suggestive and stimulating contribution to the welfare of the peoples of Africa and those who will benefit by the development of that continent that it has been my privilege to read. A. G. CHURCH.

An Anthology of Anthropology

Anthologia Anthropologica:
The Native Races of Africa and Madagascar. A Copious Selection of Passages for the Study of Social Anthropology from the Manuscript Note-books of Sir James George Frazer. Arranged and edited from the MSS. by Robert Angus Downie. Pp. xii + 578 + 10 plates. (London: Percy Lund, Humphries and Co., Ltd., 1938.) 35*s*. net.

SIR JAMES FRAZER'S method of exposition, not only in "The Golden Bough", but also in all his anthropological works, reveals both the widest reading and the meticulous care of the scholarly mind in exact quotation, or full paraphrase. This is based on a practice, which he has followed now for more than fifty years, of transcribing in his note-books the exact words of any and every authority he has consulted, when it has provided material bearing on his work. Much of this extracted material by now is familiar to his readers through his laudable habit of quotation; but there is still a considerable residue, upon which he has not drawn; and of this quite a considerable proportion comes from authors whose works are now rare, inaccessible, or forgotten. In order that this valuable collection of facts—for the extracts almost invariably are factual—may not be lost, Mr. Downey, under the supervision of Sir James, has made an anthology of the more significant and interesting passages, with bibliographical details, which he has arranged in geographical order with the view of publication in a number of volumes. The first, dealing with the native races of Africa and Madagascar, is now issued. Volumes dealing with other parts of the world (Australia, Asia, Indonesia, etc.) are to follow in due course. Sir James contributes a foreword, in which he explains the purpose of the volumes as a storehouse of valuable information from authors whose work might otherwise be lost or forgotten.

The African material here presented is arranged in seven books, each covering a part of the continent—South, East, West and so forth. Some of the material is drawn from manuscript sources communicated personally to Sir James by the authors, as for example, Prof. C. G. Seligman on his now famous investigations among the Dinka and Shilluk of the Upper Nile, and the Hon. C. K. Dundas on the peoples of Mount Elgon. Broadly speaking, authors from whom Sir James has already quoted freely, or who do not antedate the twentieth century are omitted, except where they are needed to fill what would otherwise be a gap in information, owing to recent discovery. The advantage is obvious. The facts as given here, for the most part, cannot be impeached as being in any way influenced by anthropological theory, which, as is well known, has been profoundly influenced for more than forty years by the views of Sir James on the development of the human mind

and of social and religious institutions, customs and beliefs. Thus there are no quotations from J. Roscoe's works on the natives of Uganda and related peoples. Not only has Sir James made a liberal use of Roscoe's work in his own books, but also this work was carried out in close consultation with him throughout. On the other hand, such books as H. Dale and E. W. Smith on the Ba-Ila, or C. W. Hobley's work in East Africa, are well represented, though published since the Great War, as providing evidence not otherwise available.

Detailed criticism of such a volume as this is perhaps not desired, nor is it readily feasible. Certain general reflections present themselves. Criticism may be directed against a collection of this kind on the ground that this or that item is omitted. Here the reason has been explained in part above; but it must also be remembered that an anthology is not a source-book. Its selective character must be allowed; but when the anthologist has a profound knowledge of the sources such as belongs to Sir James, criticism of his choice is a work of supererogation.

A more serious criticism attacks the value of collections of fact as such. This is a criticism of the comparative method in general, now somewhat in disfavour. It is contended that this method of study detaches the facts from their context, and further, in the hands of certain of its exponents has tended to be uncritical of its sources. The latter is a defect of the individual critical apparatus and tends to correct itself in the view of the judicious. The gravity of the former charge, however, must depend on the way in which the facts are used. Obviously, in comparative study the whole cultural context cannot be incorporated in the text of an argument; the correct use of a fact depends not on the mode of its statement in argument, but on the extent to which its user has appreciated its place in its cultural environment. Further, the purpose of the inquiry must be taken into account. The end of anthropology is the study of man as such. The inquiries to which Sir James Frazer has devoted his whole life are directed to the elucidation of the course of evolution of the human mind, not of the minds of particular groups of men. However valuable and essential the intensive study of cultural and social groups may be, especially at a time like the present when the backward races are changing with extreme rapidity, anthropology, as a science, cannot rest in the study of the particular, but must pass to the universal, if it is to vindicate its title to be a science at all.

In conclusion, it must be mentioned that this first volume of "Anthologia Anthropologica" has been produced in sumptuous manner, and the editing has been done both judiciously and with extreme care.

Science and the Chemical Industry

British Chemical Industry: its Rise and Development. By Sir Gilbert T. Morgan and Dr. D. Pratt. Pp. xii + 387 + 32 plates. (London: Edward Arnold and Co., 1938.) 21*s.* net.

THE story of chemical industry is the story of man's attempts to convert the raw materials of Nature into something more useful to himself, not by mere mechanical means, as weapons were fashioned from flints, but by transforming them into something entirely different, as, by the action of fire, limestone is changed to quicklime, or a mixture of sand and soda into glass. Some of the industries involving chemical change are of considerable antiquity, including those producing iron, gunpowder, soap, glass and pottery and the extraction of dyes from vegetable materials.

It is to the great outburst of scientific activity during the nineteenth century, following on the pioneering work of those old masters of chemistry, Priestley, Cavendish, Black, Lavoisier, Dalton and others, that modern chemical industry owes its existence. The researches of these men, by putting chemistry on a sound theoretical basis, established scientific law where formerly there was but a rough empiricism. During the nineteenth century, chemical knowledge and understanding expanded at a great rate, and not only were the changes which matter can undergo unravelled, but also the mineral and vegetable kingdoms were diligently explored, and many new and unsuspected kinds of matter were discovered. If necessity is the mother of invention, surely discovery is the father. The application of these discoveries to arts and manufactures followed, as time went on, with less and less delay until, in the twentieth century the process occurs with bewildering rapidity.

To-day, although it may not be obvious to the 'man in the street', we live in a chemical age. Superficially it may be a mechanical age, but the immense strides in the design of all kinds of machinery have been made possible only by the work of the chemists who have discovered the metals and alloys essential for their manufacture and functioning. Chemistry so pervades all branches of human activity that it is indeed difficult to distinguish, as Sir Gilbert Morgan and

Dr. Pratt point out in the book under notice, which industries should be included in the category of chemical, and which should be omitted. With reluctance they must have decided to leave out the great iron and steel industry from their survey, and also the bleaching, dyeing and finishing industries which, although not producing chemical products, are predominantly chemical in that their operations use vast quantities of chemicals and are controlled by chemists. The authors have, however, given us a most entertaining and enlightening survey of many of the most important chemical industries of Great Britain.

The book is written by chemists for chemists; that is to say, the authors' first aim is to make sure that the chemical changes underlying every process are clearly explained. Nevertheless, successful manufacture in a competitive world depends on the design of the most suitable plant for the necessary operations, and accordingly the book contains a large number of admirable diagrams and illustrations of plant and lay-out. It must be admitted, however, that a photograph of a piece of chemical plant gives as little information about how it works as does one of a modern stream-lined locomotive, and has even less æsthetic appeal. The feature of the book which distinguishes it from others of its kind is the authoritative nature of the matter it contains. The authors have been fortunate, or sufficiently persuasive, to get all the important chapters in the book reviewed and amplified by recognized authorities; it may be taken, therefore, that there are few misstatements, and that, for the more modern industrial developments, as much has been revealed of manufacturing detail as is possible at the present time.

From a descriptive point of view, there is a good deal in favour of classifying the chemical industries according to the raw materials from which they start—salt, coal, cellulose, petroleum and so on. This classification, which has been adopted in this book, immediately distinguishes those industries depending on native supplies from those which have to import their raw material. That the opening chapter should deal with the salt industries is a happy choice, since this leads to descriptions of the Le Blanc and ammonia-soda processes for sodium carbonate. The setting up of the Le Blanc process in Great Britain appears, historically speaking, to have established Britain as a great manufacturing country for heavy chemicals, and some of the greatest names in industrial chemistry are associated with its development and that of its offshoots—such names as Gamble, Crosfield, Tennant, Gossage, Chance, Claus, Deacon and Weldon. The manufacture of soda involved that of immense quantities of sulphuric acid, hydrochloric acid, chlorine, bleaching powder, caustic soda, and so on. Advances in scientific knowledge, particularly the coming of the electrolytic process for caustic soda and chlorine, provided the opportunity for a rival process, the ammonia-soda process, which starts with salt, ammonia and carbon dioxide instead of salt, limestone and sulphuric acid, to displace the Le Blanc process, which has now become obsolete. In a similar way, the contact process for sulphuric acid is gradually displacing the old lead chamber process; and since the publication of this book it has been announced that a new vanadium catalyst which cannot be poisoned has been put into the most recent plant for the contact process.

It is impossible in a short notice to say a tithe of what might be said of the romance of the rise of the chemical industry: of the spectacular increase in the production of metallic aluminium, and more recently of magnesium; of the intricacies of the isolation of the metals of the platinum group and their present-day key position; of the dyestuff industry, its rise, recession and rejuvenation in Great Britain, and the recent British discovery of the extraordinarily stable 'Monastral' (phthalocyanine) pigments, one of which is used effectively for the cover of the book; of the discovery of new drugs, including the vitamins, some of which are now being manufactured in Great Britain; of the coming of chemistry into the petroleum industry and the use of catalytic processes for improving fuels; of the utilization of the gases of the atmosphere, nitrogen for ammonia and nitric acid, argon, neon, and even krypton and xenon for electrical lamps. We cannot omit to mention the chemical processes which have given us new textile fibres, viscose and cellulose acetate, now manufactured all over the world; the importance of chemistry in agriculture; and finally chemical warfare.

What is the conclusion of the whole matter? Britain's prosperity is based on her industries, and the whole world is becoming industralized. Progress in industry has long passed the empirical stage and is dependent on the application of science —chemistry, physics, biology—in its highest forms. It is imperative that we have a succession of men of the highest type to staff our industries, thoroughly equipped scientifically, with abundant opportunities for research. The big industries of Great Britain are providing the research opportunities; auxiliary to them are the research associations and such establishments as the National Physical Laboratory and the Chemical Research Laboratory. It is for the universities to supply the trained men for industry whilst retaining within their own walls persons whose gifts are for teaching or for the pursuit of fundamental knowledge. There is some danger that the demands of industry may denude the universities to an alarming extent.

Background to Modern Science

Ten Lectures at Cambridge arranged by the History of Science Committee, 1936, by F. M. Cornford, Sir W. Dampier, Lord Rutherford, W. L. Bragg, F. W. Aston, Sir A. S. Eddington, J. A. Ryle, G. H. F. Nuttall, R. C. Punnett, J. B. S. Haldane. Edited by Joseph Needham and Walter Pagel. (Cambridge Library of Modern Science.) Pp. xii+243. (Cambridge: At the University Press, 1938.) 7*s*. 6d. net.

THE ten lectures which make up the present volume were delivered in Cambridge during 1936, under the auspices of the then newly formed History of Science Committee, and it is not surprising to learn from the preface that they were attended by crowded and enthusiastic audiences. A glance at the list of authors will show that the Committee was fortunate in being able to enlist the services of a most distinguished team of lecturers, and as the volume itself shows, it was equally fortunate in being able to secure the manuscripts of the lectures in a form suitable for publication.

Apart from introductory lectures on Greek natural philosophy and on the period stretching from Aristotle to Galileo, the remainder of the volume consists of accounts of the progress, during the past forty years, of some of the more active branches of science. Radioactivity, crystal physics, atomic theory, astronomy, pathology, parasitology, evolution theory and genetics have been selected as representing what the dust cover describes as "the cutting edge of human scientific activity". To praise the work of the distinguished authors would be both superfluous and impertinent. Within the very brief space at his disposal—some twenty-four pages—each author has succeeded in giving a vivid, personal, and authoritative 'eye-witness's account' of the progress on his own section of the scientific front. Perhaps some future volume in this excellent library will give us a co-ordinated account of the campaign as a whole.

J. A. C.

The Atlas of To-day and To-morrow

By Alexander Radó. Pp. ix+198. (London: Victor Gollancz, Ltd., 1938.) 10*s*. 6*d*. net.

AS, with the advance of science, the world shrinks, human geography grows in importance. Scarcely a generation passes but new States are created or the boundaries of old ones are revised. The present volume is admirable in scope and execution. Its aim is not to dwell upon the more or less static geographical features which find their place in the usual type of atlas, but to provide a cartographic record of that bewildering mass of political and economic problems which have such an important bearing upon the future of mankind.

A more accurate title would be "The Atlas of Yesterday and To-day". Starting from 1875 the authors picture the progressive division of the world by the great powers, the building up of colonial empires, the struggle for world markets and the control of communications, concluding with a brief summary of significant differences in religion, race, nationality and forms of government. The statistical tables are numerous, concise and instructive, but the reader is left to discover for himself which figures are well grounded and which, at best, can only be rough estimates. In the next edition, to which we may look forward confidently, the use of a comma both as comma and as decimal point (for example, in Table 4) should be avoided, and a serious error throughout the first column of figures in Table 7 should be corrected.

Library Guide for the Chemist

By Prof. Byron A. Soule. (International Chemical Series.) Pp. xiii+302. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 15*s*.

THERE are published every twelve months about fifteen hundred books, forty thousand articles and 20,000 patents of chemical interest; this flood is increasing at the rate of 6 per cent per annum. The chemist, whether he be research worker or engaged in industry, must be in touch with some portion of this literature if he is to avoid repeating work which has been done elsewhere, whilst there are many others who seek to locate chemical information beyond the purely obvious. The research student gets some kind of training in the use of a chemical library, but it is not always easy to know where to look; moreover, critical judgment as to the quality of the work consulted is an important element for success. It is valuable therefore to have a book entirely devoted to acting as a guide to this enormous literature. That before us is well done, and though of trans-Atlantic origin it will be equally serviceable in a British or European laboratory. A corollary of such work is the existence of really good libraries. Chemists are strangely lacking in a proper sense of co-operative effort and it is a stigma that the library of the Chemical Society, which is still the best in the world, is still inadequately housed and supported.

The Elements of Quantum Mechanics

By Dr. Saul Dushman. Pp. xiii+452. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 25*s*. net.

DR. DUSHMAN'S admirable book is the outcome of a series of lectures on quantum mechanics delivered by him at the Ohio State University. They were addressed to students who had not received "any intensive training in mathematics beyond calculus". This being so, the development of the various theses is somewhat leisurely but, from the pædagogic point of view, is all the better on that account. The author has selected his topics for discussion with discretion and presents them most skilfully. He deals in turn with the Schrödinger equation, potential barriers, the linear harmonic oscillator, the rigid rotator, the hydrogen and helium atoms, the hydrogen molecule, valence bonds, and the theory of radiation.

The treatment is as elementary as may be; the exposition is remarkably clear, and the book may be warmly commended as an introduction to more advanced treatises.

A. F.

Cancer: Radiological Treatment and Research

THE radiological policy of the Medical Research Council immediately after the Great War was determined by its acceptance from the Ministry of Munitions in 1919 of about two and a half grams of radium element for the purposes of experimental and clinical research. Since then the Council has systematically helped the advance of radiology, especially in its relation to cancer, and from 1922 onwards, with only one omission, it has published yearly reports from research centres in the "Medical Uses of Radium" series. The current issue for 1937* has just been published and maintains in every way the traditions of these publications. A larger section each year is devoted to pure experimental research. One of the chief values of this publication is that it gives a summary of the results of radium treatment of cancer in various parts of the body. The results are given as survival rates, and in many cases the data extend back over a period of ten years or more.

About the same time another valuable contribution, the "Report on Radium Beam Therapy Research", also under the ægis of the Council, has been published†. This report relates in detail the way in which a clinical investigation into the value of large radium units (five grams of radium element) was carried out. The research was begun in 1934 with one five-gram unit, and another similar unit was available in 1936. At the outset, it was decided to limit the research to cases of cancer of the mouth, pharynx and larynx, the reasons for this choice being that they are accessible to direct examination, and that adequate surgery is in many cases difficult and mutilating.

It is impossible here to refer to the many features which give the impression of work admirably planned and no less admirably carried out; there is scarcely a question that comes to the mind that is not answered in the text. It is a welcome sign in the radiological outlook to find a paragraph such as the following:

"It is already noteworthy that doses as large as 8,000 r have failed to sterilize some growths, whereas 4,000 r has been successful in others. It would appear that there are many factors other than dosage which have a profound influence on the response of cancer to radiation."

Turning from radiological research and treatment of cancer to the policy that is to guide its development in the future, two publications call for comment; one is the "Annual Report of the Radium Commission, 1937–1938"*, the other the text of a Cancer Bill introduced into the House of Commons on November 30 by the Minister of Health, Mr. Walter Elliot. The Bill is the result of the efforts made in the last ten years by those actively concerned in the radiological treatment of cancer. Whether it be an individual or a group or an organizing body, like the Council and Commission already mentioned, or a co-ordinated effort by the British Empire Cancer Campaign and King Edward's Hospital Fund, the result is the sum total of these efforts, and it is to show that radiological methods are of great value in the diagnosis and treatment of cancer. A national policy to ensure more facilities for cancer treatment is overdue, but none the less welcome. The main provision of the Cancer Bill is to establish a service under which, in every part of the country, modern facilities for diagnosis and treatment of cancer will be available. The Bill places an obligation on the major local authorities to consult with the Radium Commission and bodies representing voluntary hospitals and the local medical profession, and to make arrangements for securing the necessary facilities. The Bill provides for an Exchequer grant towards the cost of the new service. When the service is in full operation, the additional expenditure will amount to about £600,000 per annum for England and Wales, and £100,000 for Scotland.

A clause of the Bill provides for "loans to be made to the National Radium Trust for the purchase of additional quantities of radium. Provision is also made enabling money to be lent to the Trust under the section for the purchase of other radioactive substances and apparatus and appliances required for radiotherapeutic treatment. It is proposed that the moneys to be advanced to the Trust, not exceeding £500,000 in all, shall be repayable to the Minister with interest by way of annuities spread over appropriate periods".

Only brief reference can be made to the annual report of the Radium Commission, which includes a statistical report. The outstanding feature of the report is the information upon the use of the bigger radium units, made possible by the provision of another 10 grams of radium. Units ranging from 1 to 3 grams of radium element are in use at no fewer than seven of the national centres throughout Great Britain.

The Government purchase is going to give

* Medical Research Council. Special Report Series, No. 232: Medical Uses of Radium; Summary of Reports from Research Centres for 1937. Pp. 48+2 plates. (London: H.M. Stationery Office, 1938.) 1s. net.

† Medical Research Council. Special Report Series, No. 231: Report on Radium Beam Therapy Research, 1934–1937. By Constance A. P. Wood, L. G. Grimmett, T. A. Green and others. Pp. 77+22 plates. (London: H.M. Stationery Office, 1938.) 4s. net.

* Ninth Annual Reports of the National Radium Trust and Radium Commission, 1937–1938, including a Statistical Report. (Cmd. 5883.) Pp. 63. (London: H.M. Stationery Office, 1938.) 1s. net.

Great Britain a big interest in radium as a possession. This will inevitably entail continuous technical and chemical work, such as the filling, redistribution and concentration of radium in containers. The National Physical Laboratory has served the country well in physical measurements, but radium services have always been and will remain incomplete until a physical chemistry laboratory becomes part of the national radium and cancer service.

It is very doubtful whether any country of size and population of Great Britain is better supported and staffed in the fight against cancer, and to their credit it should be remembered that the voluntary hospitals have borne the brunt of radiotherapeutic research. It now remains to be seen how successfully individual efforts can be co-ordinated to the common good.

S. RUSS.

Scientific Centenaries in 1939

By Eng.-Capt. Edgar C. Smith, O.B.E., R.N.

ON May 26, 1639, three hundred years ago, in the ancient convent of the Jacobins, in the historic Rue St.-Honoré, Paris, there passed away at the age of seventy-one years the refugee Italian philosopher Tomaso Campanella, one of those inquiring men of unquenchable spirit, who by their determination to destroy "those errors which had become venerable by antiquity" paved the way for the free exercise of thought and investigation which is one of the treasures of the world to-day. Born at the little town of Stillo, Calabria, on September 5, 1568, he was a contemporary of Kepler and Galileo, and like the latter he incurred the hostility of the Church, although a member of it. Owing to his political activities, he was kept in confinement in Naples by the Spanish Government for more than a quarter of a century, but he was able to write several books, among which was "An Apology for Galileo". He was nearly sixty years of age when set free, but even then was kept under close observation, and in 1634, when sixty-five, he escaped from Rome to Marseilles. In France he was befriended by Louis XIII and Richelieu, and was given lodgings in the convent of the Jacobins in Paris.

The year 1639 also witnessed, not the birth or death of a famous astronomer, but the epoch-making astronomical observation of a transit of Venus, by the young Lancashire clergyman Jeremiah Horrocks. On Sunday, November 24, 1639, in between his religious duties, Horrocks had the intense gratification of witnessing, as he had expected and laboured for, the passage of the planet across the sun's disk. His friend Crabtree at Broughton, near Manchester, through Horrocks, in the late afternoon of that Sunday, also caught a glimpse of the same spectacle. "Thus did two young men, cultivating astronomy together in a state of almost complete seclusion in one of the northern counties of England, enjoy the privilege of witnessing a phenomena which human eyes had never before beheld, and which no one was destined again to see until more than a hundred years had passed away" (Grant). Hundreds of observers watched the transits of 1761 and 1769, and those of 1874 and 1882, and it was through the interest aroused by that of 1874, that a tablet to Horrocks, with an inscription by Dean Stanley, was placed on the memorial to Newton's nephew, John Conduitt, at the west end of Westminster Abbey.

Cambridge had no chair of mathematics when Horrocks was an undergraduate at Emmanuel College, and it was not until 1663 that the Lucasian professorship was founded. The first occupant of the new chair was Barrow, the second was Newton, the third was Whiston and the fourth was Nicolas Saunderson, who died at the age of fifty-seven years on April 19, 1739. Saunderson had held the chair twenty-eight years, having been appointed to succeed Whiston, who in 1710 was deprived of his post owing to his religious opinions. At this time, mathematics at Cambridge may, as Prof. Turner said, have entered a dark century which it is difficult to contemplate, but assuredly Newton had no more devoted disciple than Saunderson. Blind from the age of a year, Saunderson owed his knowledge of mathematics to the patience and generosity of friends, one of whom, Joshua Dunn, took him to reside at Cambridge in 1707. Lord Chesterfield, who was at Cambridge in 1712–14, described Saunderson as a professor "who had not the use of his own eyes, but taught others to use theirs".

Contemporaries of Saunderson in Italy and France, who made contributions to physical science and who also died in 1739, were Eustachio Manfredi (1674–1739), the elder of the two Bolognese mathematicians and hydraulic engineers bearing that surname, and Charles François Du Fay (1698–1739), who repeated and extended Gray's electrical experiments and was the discoverer of two kinds of electricity which he named the *vitreous* and the *resinous*. He also noticed the discharging power of flames. Du Fay had first been a soldier, but

abandoned the army for science and at his death was comptroller of the Jardin des Plantes, in which post he was followed by Buffon. Manfredi was for a number of years astronomer to the Bolognese Institute and was made a foreign member of both the Paris Academy of Sciences and the Royal Society.

Another tercentenary of much interest is that of the birth of Thomas Tompion (1639–1713), the 'Father' of English clockmaking, whose grave is in the nave of Westminster Abbey.

Among the men of science born two hundred years ago was the Scottish natural philosopher John Robison (1739–1805), an interesting figure in many ways. When twenty years of age, as a tutor to the son of an admiral, he was with Wolfe at the landing at Quebec; at twenty-three years of age he assisted in testing at sea John Harrison's chronometers. He lectured on chemistry at Glasgow, held the chair of natural philosophy at Edinburgh, was the first secretary of the Royal Society of Edinburgh and was the intimate of Watt, Black, Hutton, Playfair, Adam Smith and Hume. His son, Sir John Robison, was a founder of the Scottish Society of Arts.

The mathematicians George-Simon Klugel (1739–1812) and Jacques-Antoine-Joseph Cousin (1739–1800) were also born in the same year as Robison. Klugel, a professor at Halle, was the author of a dictionary of mathematics (1803–8), which was added to by some of his countrymen, while Cousin held a chair at the Collège de France for thirty-two years and another at the École Militaire for twenty years. During the French Revolution, he held public offices with success, and though imprisoned at one time, to him fell the task of ordering the use of the new system of weights and measures.

To these names may be added those of Hewson and Townsend. William Hewson (1739–74) was associated as pupil and assistant with both John and William Hunter, and at the age of thirty-one years was awarded the Copley Medal for researches on the lymphatic system in oviparous vertebrates. His promising career was cut short by poisoning from a wound received while dissecting. The Rev. Joseph Townsend (1739–1816), rector of Pewsey, Wiltshire, travelled and studied mineralogy, and in his writings endeavoured to reconcile the Mosaic record with the findings of science. He was a close friend of William Smith and was one of the first honorary members of the Geological Society.

William Smith (1769–1839) was one of three engineers who achieved fame, and passed away a century ago, the others being William Murdock (1754–1839), the right-hand man of Boulton and Watt, and the inventor of gas-lighting, for which he was awarded the Rumford Medal in 1806, and Gaspard-Clair-François-Marie-Riche de Prony (1755–1839), writer of many scientific and engineering works, engineer-in-chief of the Corps des Ponts et Chaussées and director of the Survey of France. Smith was a contemporary of Telford and Macadam, and like them travelled on his professional duties the length and breadth of Great Britain. His surveys and inspection of canals, drainage works, mines, quarries, embankments and suchlike all yielded him material for his famous geological map of England and Wales published in 1815, "the first attempt," said Von Zittel, "to represent on a large scale the geological relations of any extensive tract of ground in Europe". Smith in his later years fell on hard times, but seven years before his death he was given a Civil List pension of £100 a year. Another English man of science who died in 1839 was Davies Gilbert, who though himself an accomplished mathematician and physicist, furthered the advance of science more by his public activities than by his researches. He was president of the Royal Society from 1827 until 1830 and for a long while sat in Parliament. "He was," wrote Weld, "emphatically the representative of scientific interests in the House of Commons, and contributed by his exertions to carry many very important objects."

When Smith was laying the foundation of his fame, geology as we know it was in its infancy; when he died, geological societies were active in England, Scotland and France, the Geological Survey of Great Britain had been founded, and instead of being the pursuit mainly of a few men of leisure and of independent means, the science could count its students by the hundred. The growth of the science during last century is to some extent reflected by the fact that the year 1839 saw the birth of at least six men who achieved distinction as geologists. Henry Govier Seeley (d. 1909), a link with Sedgwick, and a Lyell medallist, was born on February 18; Arnold von Lasaulx (d. 1886) of Bonn, a pioneer in microscopic petrography, was born on June 14; James Geikie (d. 1915), the holder of the Murchison chair at Edinburgh, was born on August 23; Karl von Zittel (d. 1904) of Munich, the author of the well-known "History of Geology and Palæontology", was born on September 25; Edmund Mojsisovics von Mojsvár (d. 1907) a pupil of Suess, and vice-director of the Geological Institute of Vienna, was born on October 18, while the French geologist Albert de Lapparent (d. 1908) who served as president of the French Geological Society and as permanent secretary to the Paris Academy of Sciences, was born on December 30, 1839.

Of men famous in other branches of science who also were born a century ago, the list includes the names of Mond, Eliot, Kundt, Gibbs and Thurston, Ludwig Mond (1839–96), the great industrial

chemist, came to England fresh from the laboratories of Kolbe, Bunsen and Kirchhoff, and stayed to build up the famous firm of Brunner, Mond and Co. and to found the Davy Faraday Research Laboratory at the Royal Institution. Sir John Eliot (1839–1908), from St. John's College, Cambridge, went to teach mathematics in India and became the Director-General of the Indian Meteoro logical Service, benefiting both those ashore and afloat by his study of cyclones. August Kundt (1839–94), the successor of Helmholtz at Berlin, is remembered for his original investigations in sound and light. Josiah Willard Gibbs (1839–1903), of Yale, was Copley medallist in 1901. He was", said Sir William Huggins, "the first to apply the second law of thermodynamics to the discussion of the relation between chemical, electrical and thermal energy". His name will always be associated with the Phase Rule.

In his own particular sphere, none occupied a more prominent place than the American engineer and educationist Robert Henry Thurston (1839–1903). At the Stevens Institute, Hoboken, Thurston organized the first mechanical engineering laboratory in the United States, while at Sibley College, Cornell University, whither he went in 1885, he saw the number of engineering students under him grow from a total of sixty to 900. He was a founder and the first president of the American Society of Mechanical Engineers.

In conclusion, attention may be directed to one or two of the outstanding scientific books published in the year 1839, and one or two events which excited considerable interest, or proved of lasting importance, to the world of science. Among the books were the first volume of Faraday's "Experimental Researches in Electricity" and Darwin's "Journal and Remarks, 1832–36", which appeared as the third volume of Fitz Roy's "Voyages of the Adventure and Beagle". Of Darwin's work the *Quarterly Review* said, "We find ample materials for deep thinking; we have the vivid description that fills the mind's eye with brighter pictures than painter can present, and the charm arising from the freshness of heart which is thrown over these virgin pages of a strong intellectual man, and an acute and deep observer". Another notable book was Murchison's "The Silurian System", which Sir Archibald Geikie called a "splendid monograph with which it was now possible to carry the vision across a vast series of ages, of which hitherto no definite knowledge existed", and yet another, W. H. Miller's "Treatise on Crystallography".

The year 1839 was also marked by the announcement by the naturalists Theodor Schwann (1810–82) and Matthias Jakob Schleiden (1804–81) that all the higher animals and plants are made up of cells; by the invention by Sir W. R. Grove of his battery experiments with which Schönbein was led to his observations on ozone; by the discovery by Charles Goodyear of his process of the vulcanization of rubber, and by the first trials of the historic pioneer screw-driven vessel *Archimedes*. But nothing excited more enthusiasm in scientific circles than the publication of the account of Daguerre's method of obtaining pictures on metal plates. On January 7, 1839, Arago communicated Daguerre's invention to the Paris Academy of Sciences, and in the summer the French Government purchased the invention, making the inventor an officer of the Legion of Honour and awarding him a pension of 6,000 francs. A fortnight after Arago lectured at the Academy of Sciences, Faraday at the Royal Institution described Fox Talbot's invention of "photogenic drawing". These were both notable steps in the early progress of photography.

Potato Problems*

By Dr. S. Linné, Ethnographical Museum of Sweden, Stockholm

THE native peoples of America were clever botanists, and the culture inherited from the Indians has supplied humanity with numerous cultivated plants of inestimable value; for example, the potato, maize, cacao, tobacco, tomato, etc. The potato is certainly the most important, along with maize. In four Masters Lectures before the Royal Horticultural Society, Dr. Salaman has presented the latest discoveries and the results of his own investigations and of those of others concerning the potato in ancient and present times in America, and its introduction into Europe.

It is certainly not surprising that this important cultivated plant, and the question as to its origin, have attracted the attention of botanists, but Dr. Salaman is the first scientist to have studied the potato problem not only from an archæological,

*The Potato in its Early Home and its Introduction into Europe. Masters Lectures, 1936, by Redcliffe N. Salaman (*Journal of the Royal Horticultural Society*. Vol. 62. Pp. 53+46 figs. London, 1937.)
A brief summary in which certain points of view have been revised has since been given in a discourse entitled "The Origin of the Potato and its Influence on Man's Early Settlement in South America, published in the *Proceedings of the Royal Institution of Great Britain* (30, No. 141, pp. 26+9 figs., 1938).

but also from a 'psychological', point of view. By way of introduction he points out that Russian savants conducted several expeditions during 1926–32 and greatly increased our botanical knowledge of the potato, establishing, among other things, that the majority of the thirteen tuber-bearing species of *Solanum* have, from earliest times, been cultivated by the Indians of South America. They have further demonstrated that the potato, numerous wild forms of which exist from Colorado to Chile, but which was only cultivated in South America in pre-Columbian times, developed in two distinct areas. They are the Peruvian and Bolivian plateaux (*Solanum andigenum*) and the Island of Chiloe and neighbouring parts of the Chilean coast (*Solanum tuberosum*). The common domestic potato of Europe, and *S. tuberosum*, are identical, and according to the Russian investigators it then follows that the potato introduced into Europe towards the end of the sixteenth century came from Chile.

Dr. Salaman, however, holds an entirely different opinion, and the evidence presented by him appears to be irrefutable. First of all, the parts of the Chilean coast referred to had not yet been conquered by the Spaniards, for the natives made very stubborn resistance, and it must thus have been rather a difficult task to obtain potatoes there. Even though it may have been possible, the crop would then have been harvested at a very unsuitable time for the potatoes to be set in Europe. Chile is in the southern hemisphere and the potato is harvested in April. Considering the communications at that time, the potatoes would be of no use for planting on their arrival in Europe; and they also would have been stored for some time in the tropics. In the Peruvian and Boïvian highlands with their varying nature, however, it would have been possible to select a more suitable time. The difficulties of transportation would have been considerably simplified if seed had been taken instead of tubers, but this must be considered excluded. The Indians, who taught the Spaniards how to cultivate potatoes, always planted tubers, and still do, and it was European botanists who later became interested in the seeds.

Also, from a botanical point of view, difference between *S. andigenum* and *S. tuberosum* is so small that, according to Dr. Salaman's analyses, it cannot be definitely determined whether the European potato had its origin in one or the other. It is known from the time that the potato was first cultivated in Europe that it set seed freely, which is a characteristic of *S. andigenum*. Seedlings were raised, and new varieties were soon produced. The Indians cultivate about one hundred varieties, and everything indicates that they had a very rich assortment also in early times. At village fairs in southern Peru, the natives have been seen to offer for sale more than sixty different varieties of potatoes.

As regards the introduction of the potato into Europe, it has hitherto been considered that 1588 was the earliest fixed date. The potato was then cultivated in Italy, having come from Spain. However, thanks to various data in the literature hitherto overlooked, Salaman has succeeded in demonstrating that it was cultivated in the neighbourhood of Seville in 1572, and he considers it likely that it was first introduced at least ten years earlier.

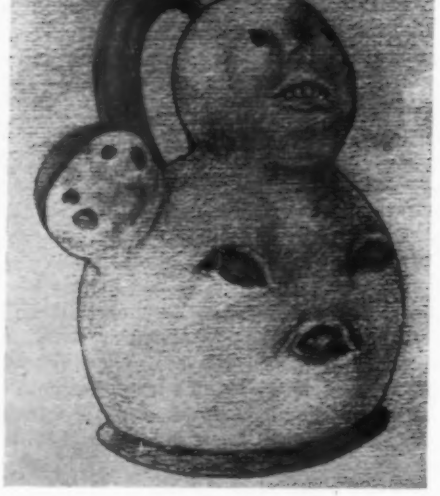
A little later, but quite independent of Spain, the potato made its second entry into Europe, this time into England. However, it did not come from Virginia, as is often stated; for it is not native there and was not introduced there until more than a hundred years later. Salaman is of the opinion that Sir Walter Raleigh should have the credit of being the first to introduce and plant potatoes in England, and that this was in 1586. There is as yet no absolutely conclusive proof of this very momentous event, but apparently the introduction occurred on two occasions, quite independently, in Spain and in England, the potato thence finding its way to the rest of Europe. In both cases, the potato derived its origin from Peru, Bolivia, Ecuador, or Columbia, but scarcely from Chile.

We can obtain a knowledge of the early history of the potato and of its use in America from the chroniclers of the conquest and from the pottery found in pre-Spanish graves on the Peruvian coast. Seeing that the art of writing was unknown in South America, it is the archæological investigations alone that can throw light upon the history of the country prior to the arrival of the Spaniards. The pottery thus plays a prominent part; for the wonderfully shaped ware of the Peruvian people portrays human beings and animals, weapons and tools, scenes of everyday life, battles and religious ceremonies. The pottery from Chimu, on the northern part of the Peruvian coast, is especially outstanding in virtue of its ever-varying choice of motifs, vivid naturalism combined with a keen eye for artistic effects and unsurpassed technical skill. Five consecutive periods can be distinguished and be dated approximately, from the beginning of our era up to the arrival of the Spaniards and the downfall of Inca in 1533. The Chimu ware is thus also the main source of our knowledge of the use of the potato in prehistoric times and of the religious conceptions attached to it.

The potato was cultivated in the highland valleys and plateaux of the Andes, but for climatic reasons it was not cultivated on the slopes towards

the coast or on the actual coast, that is, in the river valleys, which, separated from each other by stretches of deserts, were the only districts suitable for agriculture, especially for the cultivation of maize. Several types must have been raised at a very early date: *inter alia*, a hybrid form which was rather frost-hardy. It is very probable that, in its native country, the potato has been cultivated for three millenniums.

It is strange that only in the pottery of the coastline do we find reproductions of the potato. This is due to the fact that the highland ware on



YELLOW ANTHROPOMORPHIC POT FROM CHIMBOTE. FIGURE COMPOSED OF POTATO TUBERS WITH PRONOUNCED 'EYES'. NOTE THE EXCISED NOSE AND RESECTED UPPER LIP. Reproduced by permission of the Council from *J. Roy. Hort. Soc.*, **62** (1937).

the whole has no reproductions of either human beings, animals, or other objects. Thanks to the dry climate—there is practically no rain—and the high nitrate content of the soil, everything that was deposited in the graves on the coast has been preserved. Even in the graves dating from the oldest Chimu culture has there been discovered pottery in the shape of potatoes and chuño, that is, preserved potatoes. The manner of producing chuño, freezing, treading on the tubers spread on the ground, with the view of squeezing the water out of them, and drying, is to this day the same as that described by the Spaniards four hundred years ago, and was undoubtedly the same two thousand years earlier. Probably chuño is one of the first preserved foodstuffs that ever existed. Not until potatoes were cultivated and this method of preservation introduced could the Peruvian and Bolivian highlands feed a more numerous and permanent population. It is thus impossible to over-rate the importance not only of the potato but also of chuño for man's conquest of these territories.

One of the theories upon which Salaman founds considerable parts of his historical comments is that the Peruvian coastal population crossed the mountains from the South American primitive forests. This is connected with his opinions as to how man originally took possession of the continent, and here the presence of chuño in the graves on the Peruvian coast plays a prominent part. Salaman considers that the immigrants were unable to penetrate the Isthmus of Panama on account of its rain-forests and its generally inhospitable nature. In the event of their crossing from Central America to South America in canoes, chuño, which did not exist in Central America, would not have been found in the graves on the coast. Certainly the woods in the Isthmus of Panama are difficult to penetrate, and I know from my own experience that this is true with reference to Europeans but not as regards the natives. Nor must the fact be forgotten that the whole Isthmus has from ancient times been inhabited by native tribes, and that even they have produced cultures of a high level. Furthermore, the Peruvian coast was undoubtedly populated long before the potato was common food and before the culture flourished from which Salaman has obtained his archæological proof. This is demonstrated, *inter alia*, by the remains found after the primitive fisher population at Arica and other places.

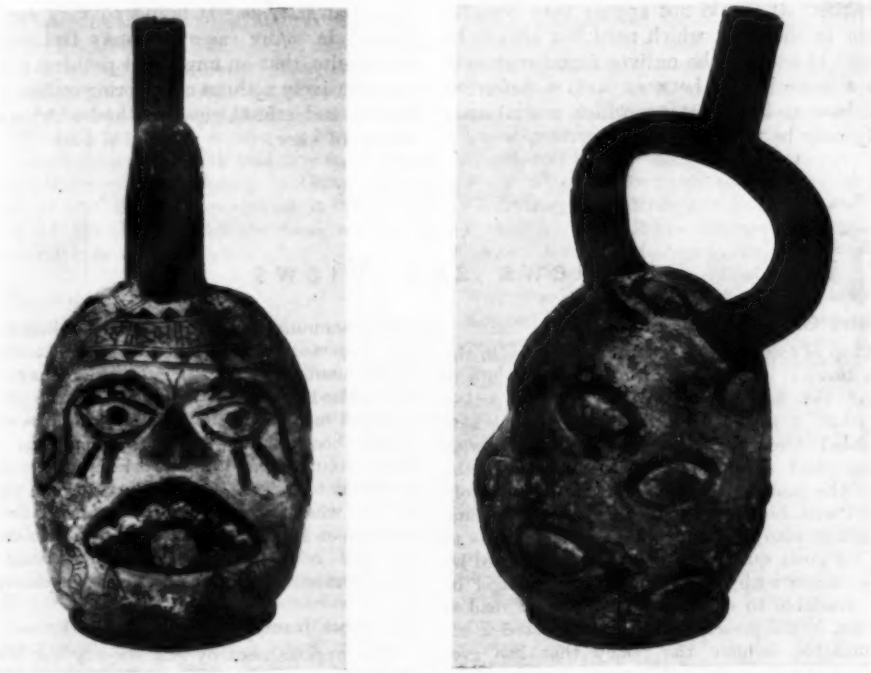
That "the original settlers reached South America via the great river systems of the Orinoco and the Amazon" is a hypothesis that remains to be proved, and can be accepted only when further reasons have been produced. According to Salaman, these early immigrants found little attraction in the forest and river districts and made their way up the high Andes. The reason for their doing so he considers can be expressed "in the one word fear", which would appear to be rather too simple an explanation, especially as the forests had quite a considerable Indian population which have produced rather highly developed cultures, suited to the conditions, and satisfactory for their existence. We are unable to determine what occurred in a dim and distant past when South America was gradually becoming populated by immigrants from the north. Weaker peoples were elbowed out by stronger ones; migrations and

displacements were continually occurring due to various causes. Undoubtedly, the jungle and rain-forests were not populated very extensively until comparatively late; primitive culture as well as real civilization belonging to the dry territories.

The above-mentioned Chimu vessels with potato motifs have been arranged by Dr. Salaman in certain groups with special reference to the motifs, these groups also being chronologically separated from each other. Those dating from the oldest period are mainly anthropomorphic, that is, having human shapes, but they display tuber-like parts in which the 'eyes' of the potato are represented. The majority portray human beings with mutilated faces; nose and lips have been cut off. The oldest vessels are most severely mutilated; in the later ones the mutilation is often merely indicated, and finally it was limited to the removal of the upper lip.

Later, there appear no mutilations, though the pots maintain their anthropomorphic type, but with tuber-like projections and the stigmata of the potato eye. Gradually the human shape attracts less and less interest and the potato-shape becomes more and more predominant. During the Late Chimu period the realism at last almost disappears: thus also the mutilations, and the tuber-like form, are increasingly suppressed. During the Inca period, finally, there are seen only faint traces of the eyes, the potato-shape, too, having almost vanished.

Dr. Salaman is of the opinion that the mutilation of the nose and lips is a kind of ritual sacrifice. For reasons unknown, he assumes that "for the sake of the potato" the coastal population originally sacrificed human beings, but that later they contented themselves with the mutilation, which was finally replaced by merely removing the upper lip. The Peruvian potato tuber is often blood-red, with very deep eyes surrounded by a brow. According to Dr. Salaman's hypothesis, the natives looked upon the eyes as a mouth from which the new buds stood out like teeth. As the potato-spirit had to be given new strength to replace what had been consumed, this would be accomplished by a sacrifice which in some manner was connected with the potato's most important part. Experience had taught the native that the bigger the mouth and the more prominent the teeth, the richer was the crop. By removing the lips and denuding the teeth of the sacrifice, the resemblance to the potato mouth was created, and the potato-spirit could not be mistaken as to what was expected from him.



PROTO-CHIMU ANTHROPOMORPHIC POT FROM TRUJILLO. CREAM AND RED. FRONT AND BACK VIEW SHOWING EXTREME MUTILATION OF NOSE AND MOUTH. BACK OF HEAD ORNAMENTED WITH POTATO EYES. Reproduced by the permission of the Council from *J. Roy. Hort. Soc.*, **62** (1937).

I regret to say that I can scarcely follow, and still less agree with, these views. We do not know the part played by the potato in the household of the coastal population, nor do we know whether or not chuño was present in the graves of pilgrims from the mountains. It certainly seems very improbable that the coastal population should have made sacrifices to the potato-spirit operating in the highland districts, with which they had nothing to do but to purchase his products. There are, moreover, numerous vessels portraying mutilated faces which have nothing whatever to do with the potato, and which medical specialists have presumed to represent morbid changes, *inter alia*, syphilis. It would not appear very remarkable that, in their art, which need not always be of a magic character, the natives found reason to express a resemblance between a face deformed by a disease and the potato, which resemblance certainly may be striking.

As a support for his theory, Dr. Salaman has collected a large number of instances of sacrifices and ceremonies of various kinds connected with the setting and harvesting of potatoes from the discovery of South America to the present day. These rites subsist as an echo of ancient times, but they do not prove that the coastal people sacrificed human beings to the potato-spirit, or that the mutilation portrayed by the pots is an expression of a fertility rite.

Dr. Salaman's studies overflow with interesting, personal working theories, which, however, in many cases cannot very well be made to agree with our knowledge of the customs of the South American natives. It is indeed very satisfactory, though in many cases one may feel sceptical of the results, that an important problem is discussed so extensively without considering ordinary archæological and ethnological methods and with fresh points of view.

News and Views

Sir Richard Gregory, Bart., F.R.S.

A PERIOD of forty-five years is but as a day in the life of a State; it is a large fraction of the life of one man. Yet, as will be seen from the first article in this issue, it represents the period during which Sir Richard Gregory has been associated with NATURE; and since 1919 he has governed the policy of the journal, which has become intimately associated with his name. His retirement will come as a shock to many readers, and it will be a loss to all that his great qualities of leadership, matured by long association with the journal, will no longer be directly available to us. In his message to readers of NATURE, in the present issue, he has stated in his own inimitable fashion the policy that has ever guided and encouraged his labours for science and for humanity, and there is no need to elaborate them here. They may be summed up in two phrases: a clear recognition of the importance of the reactions of advances in science on the well-being of the community, and intense faithfulness to the ideals of the freedom of learning and its independence of national boundaries, of caste and of creed.

NATURE, probably more than any other periodical of its age and status—it will shortly celebrate the seventieth anniversary of its birthday—has preserved a consistency of outlook which has widened rather than changed fundamentally with the changing years. This is in great measure due to the wisdom and foresight of the two editors, Sir Norman Lockyer and Sir Richard Gregory, who have for so long a period guided its fortunes. Sir Richard, in particular, clearly perceived the increasingly large share which science was bound to take in moulding the social life of the community, and the corresponding increase in the responsibilities of the man of science towards that community whose fate may—nay, will—be determined by the use, or misuse, of the powers that he puts into its hands. These views have, of late years, been elaborated with increasing force in these columns, and the world at large is deeply indebted to Sir Richard Gregory for the vigour and clarity with which he has expounded them. His retirement from active participation in NATURE will, we trust, release him for yet further public work for the advancement of civilization and progressive science.

Sir James Jeans, O.M., F.R.S.

THE appointment by His Majesty the King of Sir James Jeans to the Order of Merit is a well-deserved reward for outstanding work in mathematical physics and astronomy. Jeans's earliest investigations were concerned with the dynamical theory of gases; by the use of generalized co-ordinates, he gave a rigid proof of Maxwell's law of distribution of molecular velocities, and of the theorem of equipartition of energy. He also improved the theory of viscosity and made important contributions to the theory of radiation and of quanta. When a pupil of Sir George Darwin, he had become interested in the difficult problem of the stability of the pear-shaped form of rotating, incompressible, gravitating fluid. Darwin, Poincaré and Liapounoff had discussed this with discordant results. By a masterly piece of analysis, carried to a third-order approximation, Jeans was able to show that this form was unstable. He then turned to the more difficult problem, which is of greater importance for cosmogony, of a rotating mass of compressible fluid, and showed that for a

density greater than a certain critical value, the behaviour is generally similar to that of the incompressible fluid, but that for lower densities equatorial break-up, by ejection of matter from the equator, will occur. These results were applied to the evolution of the solar system, binary stars and spiral nebulæ in an essay that was awarded the Adams Prize in 1916. The conception of gravitional instability as a cause of the separation of primitive material was due to Jeans. In his important investigations in stellar dynamics, the methods that he had developed for the kinetic theory of gases were applied to the stars.

In recent years, Jeans has written a number of popular books on astronomy and physics which have had a world-wide circulation and have done much to create an interest in the more recent developments in these branches of science. Jeans served as secretary of the Royal Society from 1919 until 1929, and as president of the Royal Astronomical Society from 1925 until 1927. He received a Royal Medal of the Royal Society in 1919 and the Gold Medal of the Royal Astronomical Society in 1922. He was president of the British Association in 1934, and president of the Indian Science Congress at its jubilee meeting in 1938.

New Year Honours

The following names of men of science and others associated with scientific work also appear in the New Year Honours list: *Baronet:* Hon. Surgeon Commander J. D. Pollock, for benefactions and services to education. *G.C.M.G.:* Lord Hailey, director of the African Research Survey. *G.C.V.O.:* Sir John Reith. *G.B.E.:* Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, lately secretary of the Royal Society. *K.C.M.G.:* Sir Algernon Aspinall, lately secretary to the West India Committee. *Knights:* The Hon. Walter Gordon Duncan, president of the Royal Agricultural and Horticultural Society, South Australia; Prof. W. W. Jameson, dean and professor of public health, London School of Hygiene and Tropical Medicine; Prof. R. Robinson, Waynflete professor of chemistry in the University of Oxford; Mr. Will Spens, master of Corpus Christi College, Cambridge; Prof. R. G. Stapledon, professor of agricultural botany, University College of Wales, and director of the Welsh Plant Breeding Station, Aberystwyth. *C.B.:* Mr. A. T. A. Dobson, fisheries secretary, Ministry of Agriculture and Fisheries. *C.M.G.:* Mr. J. N. Oliphant, director of the Imperial Forestry Institute, Oxford. *C.I.E.:* Dr. W. Burns, agricultural expert to the Government of India in the Imperial Council of Agricultural Research Department; Lieut.-Colonel G. Covell, director of the Malaria Survey of India; Mr. A. C. Hiley, chief conservator of forests, Bombay; Mr. H. B. Dunnicliff, chief chemist, Central Revenues Chemical Service, and principal of the Government College, Lahore; Lieut.-Colonel E. W. O'G. Kirwan, professor of ophthalmic surgery, Medical College, Calcutta, Bengal. *C.B.E.:* Mr. W. F. Brown, chief mineral adviser to the Commissioners of Crown Lands, member of the board of governors of the Imperial Institute and of the Institute's Advisory Council on Minerals; Dr. A. S. Griffith, bacteriologist, Medical Research Council; Mr. R. P. Nicholson, lately secretary of the Royal African Society; Mr. F. C. Starling, assistant secretary and director of the Petroleum Department, Mines Department.

O.B.E.: Prof. W. E. Agar, professor of zoology, University of Melbourne; Dr. H. R. Angell, senior pathologist of plant industry, Council for Scientific and Industrial Research, Commonwealth of Australia; Lieut.-Colonel K. R. Krishnaswami Ayyangar, lately director of the Pasteur Institute of Southern India, Coonoor; Mr. B. E. Frayling, chief inspector of mines, Tanganyika Territory; Mr. P. A. Godwin, director of surveys and lands, Sierra Leone; Mr. D. K. S. Grant, conservator of forests, Tanganyika Territory; Prof. C. J. Hawkes, professor of engineering, King's College, Newcastle, member of the Departmental Committee on the Examination of Engineers in the Mercantile Marine, 1937; Mr. W. F. Higgins, secretary of the National Physical Laboratory, Department of Scientific and Industrial Research; Miss Hilda Matheson, secretary to the African Research Survey; Mr. T. Rowatt, director of the Royal Scottish Museum; Mr. J. E. A. Wolryche-Whitmore, for services to agriculture in Kenya. *M.B.E.:* Mr. D. O. Drummond, deputy conservator of forests, United Provinces, India; Mr. R. T. M. Hayter, assistant director of the School of Tropical Medicine and resident medical officer, Carmichael Hospital, Calcutta, Bengal; Mr. O. H. C. Shelswell, lately personal assistant to the chief conservator of forests, Madras.

Captain B. S. Cohen, O.B.E.

Captain Bertram S. Cohen, who retired from the post of staff engineer in charge of the Post Office Research Station at Dollis Hill, London, at the end of December, has been for forty years improving instruments and developing methods used in telephony. He joined the National Telephone Co. in 1896, the year in which the Post Office bought the long-distance telephone lines throughout the United Kingdom. As early as 1900, when Sir Oliver Lodge demonstrated his hornless loudspeaker before the Institution of Electrical Engineers, Cohen was one of the first to recognize the clearness of the articulation of the device, the faithful reproduction of radio telephony greatly impressing him. In conjunction with G. M. Shepherd he did excellent work in applying some of Heaviside's work to long-distance transmission over telephone lines. With impressive thoroughness, they evaluated the solutions of the very lengthy and difficult equations, sometimes involving inverse hyperbolic functions, which were continually arising in their experimental work. Cohen contributed a paper to the Physical Society in which he discussed the alterations in the everyday solutions due to the fact that the 'constants', such as the resistance, in some of the differential equations were really variables, and the solutions consisted of terms having

different frequencies. He received the O.B.E. for the excellent work he did in telephony during the Great War. The Institution of Electrical Engineers awarded him the Fahie Premium and an 'extra' premium for two of his papers; he is now president of the Meter and Instrument Section of the Institution. He leaves the Post Office with the good wishes of all his colleagues.

South Africa's 'Men-Apes'

THE chief findings of a report on the teeth of the fossil 'men-apes' of South Africa by Prof. W. K. Gregory and Dr. Milo Hellman of the American Museum of Natural History, New York, which are cited in a communication by them in another column of this issue of NATURE (see p. 25) tend both to confirm, and at the same time to extend, the implication of Dr. Broom's diagnosis of the human affinities of his recently discovered relics of new types of fossil prehominids. As a result of a personal inspection of the finds, these two authorities, whose judgment carries conclusive weight in view of their experience in the examination of the dentition of fossil ape-forms from the Himalayan tertiary deposits, give it as their considered opinion that "the dentition of the adult forms described by Broom present many transitional or annectant conditions between the pithecoid and human stages". They go on to support and illustrate this pronouncement by reference to details of the dentition of one of these forms, namely *Plesianthropus*. For example, a canine of the female specimen is said to "require but little additional modification to attain the human status". What, however, is of special significance is that Prof. Gregory and his colleague find in the Indian fossil forms transitional stages leading to the almost human premolar of *Plesianthropus*, while another tooth of the South African type takes an intermediate position between *Sivapithecus*, one of the fossil anthropoids from the Siwaliks, and Peking man. A further significant suggestion, based on comparative evidence, is that the general condition of the teeth points to a stage of transition from the frugivorous habits of the ape to the omnivorous habits of man.

Phylogeny and Chronology in the Descent of Man

IT may be noted that the conclusions at which Prof. Gregory and Dr. Hellman have arrived in regard to the dentition of the South African fossil men-apes by no means dissipate, but rather intensify, the chronological difficulties which, as has been pointed out previously, arise from these discoveries and from the inferences drawn from them by Dr. Broom. A phylogenetic succession is in process of being established in South Africa which chronologically is at variance with—that is, is later in time than—the chronological position assigned on geological and palæontological evidence to early types, definitely human in character, found elsewhere, such as, for example, Peking man. In other words, this South African series is too late in date for inclusion in the human phylum, and must belong to an analogous line of development which ultimately dies out.

IN this connexion, reference may be made to a communication which has been received from Prof. Franz Weidenreich, of the Cenozoic Research Laboratory, Peiping, who directs attention to the fact that he had already arrived at the conclusion from the *Sinanthropus* findings that the adoption of the upright posture and gait had preceded the decisive changes of brain and dentition; and he goes on to suggest that the parts upon which Dr. Broom relies, especially the lower end of the humerus, are not so strikingly different from those of modern chimpanzees as are the shafts and proportions of the long bones. In regard to the chronological problem in particular, he refers to two communications by himself, one appearing in *Biomorphosis* (**1**, 1; 1938), and the other presented to the Congress of Anthropological and Ethnological Sciences, Copenhagen (1938), in the course of which the discrepancy between the morphological and the chronological sequences of hominid remains is set out in detail in relation to geographical distribution. The interpretation of the evidence put forward by Prof. Weidenreich in an attempt to reconcile the two series, is that we must not look for a single place of origin in man's evolution, but that there must have been at least four centres in which the line of man has developed independently: south-eastern Asia, giving rise to the Australian type of modern man; eastern Asia, giving rise to the Mongolian; Africa, where Rhodesian man filiates with the Negro; and Palestine or western Asia, from which the European type originated. He is careful to point out that this polycentric evolution of man does not imply a polygenetic origin.

The Kut Barrage Irrigation Scheme

THE last day of 1938 was notable in the sphere of civil engineering operations by reason of the completion of an important four-year undertaking (begun in December, 1934) which has comprised the construction in Iraq of a barrage, 1,500 ft. long, across the River Tigris, and, as an adjunct, of an irrigation canal, 2¼ miles in length and 230 ft. wide, with a head regulator to control the flow of water down the Gharraff River. The object of the Government of Iraq in executing the work is to bring into cultivation extensive areas of land on both sides of the Shatt-el-Gharraff from Kut to Ur, between the Rivers Tigris and Euphrates, on the traditional site of the Garden of Eden. Previously, supplies of water have been available for the Gharraff River only during periods of flood in the Tigris; henceforward, the Kut Barrage will retain the water of the Tigris and cause it to flow at all seasons along the diversion canal into the Gharraff River. The barrage has fifty-six sluice gates, each 20 ft. wide, to control the rate of flow, while a navigation lock will enable river craft to pass the obstruction and maintain the service of boats between Bagdad and Basrah. The formation of the canal involved the excavation of 1,600,000 cubic yards of material and the employment of 2,500 Arabs and Kurds. In addition, 250,000 cubic yards of concrete were placed in the barrage. The regulator at the head of the canal is equipped with seven sluice

gates, each 20 ft. wide, and there is a small navigation lock. The constructional operations were seriously hampered in November 1936 by extensive rains, which produced the highest flood on record on the Tigris for that season of the year, and rose with such unprecedented rapidity that the works were entirely inundated and brought to a standstill. A further difficulty was the extraordinary range of temperature, which varied from freezing point in winter to 125° F. in the shade in summer. The engineers for the undertaking were Messrs. Coode, Wilson, Mitchell and Vaughan-Lee of Westminster, and the contract was entrusted to Messrs. Balfour, Beatty and Co., Ltd., of London.

School of Oriental Studies

THE School of Oriental Studies in the University of London, it is stated in the report of the Governing Body for the academic year 1937–38, will vacate the premises at Vandon House, Westminster, now in temporary occupation, for the new building on the Bloomsbury site of the University, in March 1941. Owing to the inconvenience of present arrangements, removal at the earliest possible date has become imperative. At the moment, not only has the library to be housed in another part of Westminster, away from the academic and administrative work of the School, but also a large part of the collection of Chinese and Far-Eastern books, some 16,000 in number, brought together by the late Sir Reginald F. Johnston, professor of Chinese in the University of London, and presented to the library by his executrix, cannot be utilized and must be kept in store. The work of the School, which covers a wide range, now includes in addition to the study of languages, lectures on the religions of the Orient, Indian art, archæology, and philosophy, Burmese law, history, and economics, Buddhist law, and Indian social welfare. In the school of languages during the academic year instruction was given in Arabic, Persian, Sanskrit, Malay, Hindustani, Chinese, Japanese, and Burmese, the number of students in each being in the order named; while in the African Department there were students in such little known tongues as Efik, Ibo, Lunyoro, Shona, Tswana, Twi, Yao, Yoruba, and Zande. The extent to which these facilities are appreciated is shown by the fact that there were in 1937–38, 85 full-time students, 94 part-time, 197 occasional, and 73 inter-collegiate students, making 449 in all, an increase of 21 on the numbers of the preceding year. Since the death of Sir Montague Butler, chairman of the governing body, in March last, Lord Harlech, formerly Secretary of State for the Colonies, has accepted that office.

Geological Museum: Recent Acquisition

RECENT additions to the collections of the Geological Museum include a number of specimens of beautifully banded pink rhodochrosite, from Minas Capillitas, Catamarca, Argentina. This mineral, which is the carbonate of zinc, is of a rich pink colour, the specimens being of stalactitic formation. Although previously employed as a semi-precious stone, its use has hitherto been relatively rare: but rhodochrosite from the same source as the Museum specimens was recently utilized in London under the name of 'Inca Rose', in various Christmas gifts, to form an inlay at the edges of white marble-onyx cigarette boxes, and in similar ornamental work in which malachite or lapis lazuli is frequently used. The mineral was collected by Dr. Franz Mansfeld from an old mine, until recently deserted, situated at an altitude of about 10,000 ft., in the Andes. The Museum has also received as a gift from Mr. T. C. F. Hall a small collection of specimens of alluvial gold from Abyssinia and Korea. The Abyssinian specimens include a sample of gold dust, associated with particles of iron ore, in a feather quill, as brought in by the natives. Other acquisitions include two very fine stalagmitic and stalactitic specimens of melanterite (ferrous sulphate) from Millclose Mine, Warrenear, Derbyshire, presented by Prof. W. G. Fearnsides; and a large crystal of corundum or impure ruby some five inches in length and three inches in diameter. A number of specimens of seepages of mineral oil found associated with British coal-seams have also been placed on exhibition.

Articulation of Secondary with University Education

THE United States Office of Education has issued a report, entitled "Some Factors in the Adjustment of College Students", of elaborate investigations of university entrance conditions in relation to the varying needs and capacities of individual students. Seven factors have been studied: articulation of high-school and university subject areas, extra-curricular activities, lapse of time between leaving high school and admission to university, age on admission, high-school marks, aptitude and achievement test results, effect on university students of simultaneously engaging in gainful occupations. It is suggested that university courses be made to fit entering students either by dovetailing them with the high-school courses or "by setting up a few broad, comprehensive courses which challenge the interest and ability of the student" as in the University of Chicago (the humanities, the social sciences, the physical sciences, and the biological sciences). The report concludes with a formulation of the following desiderata: a more comprehensive system of record-keeping in the high-school for use in guidance of students; utilization by universities in admitting or guiding the student of as many items of knowledge concerning him or her as possible and, to this end, the provision by them of facilities for testing and interviewing them; integration of the work of the high school and the university through facilities for students of different levels of general scholastic aptitude; and shepherding of students into particular courses in accordance with their past achievements.

Library Service in the United States

A REPORT on library service, prepared by C. B. Joeckel for the Advisory Committee on Education, has been issued by the U.S. Government Printing Office. The survey indicates that the total library

resources of the United States are great but are unequally distributed among the major geographic regions, the different population groups and the various kinds of library service. In all types of library service the north-east and the far west are in a preferred position, while the southern regions are definitely inferior. Urban population is much better served than rural areas, and the library needs of the scholar and the student are usually better supplied than those of the general reader. Again, more than four fifths of public libraries in the United States have incomes of less than the lowest limit usually defended as efficient and only four per cent have incomes of more than 25,000 dollars, the minimum income for an efficient library unit, according to some investigators. Control over the many types of libraries is dispersed among the Federal, State and local Governments, and between public and private educational authorities. Only a small beginning has been made in the planned integration of the library resources of the nation. The library services of the Federal Government itself are generally excellent, but could be improved and extended at relatively moderate cost; and the report details ways in which the Federal Government could improve the general situation by improving the organization and national services of its own libraries, by assistance in the development of regional library service and by grants-in-aid to libraries.

Mortality Rates in the 'Depressed Areas'

IN a report entitled "A Study of the Trend of Mortality Rates in Urban Communities of England and Wales, with Special Reference to 'Depressed Areas'" (*Reps. on Pub. Health and Med. Subjects*, No. 86. London: H.M. Stationery Office. 1*s.* net), Dr. Lewis-Faning gives the results of an investigation on the effect of trade depression on the national health. Such investigation must be based upon mortality rates, as complete statistics of sickness rates are not available. Standardized death-rates of all the county boroughs within the depressed areas were calculated, and were compared with the standardized rate of mortality for the whole country and with that of a group of county boroughs in prosperous areas, for the same periods. Dr. Lewis-Faning's conclusion is that there is no evidence from the trend of mortality rates from all causes of death that the health of the population of the depressed areas of the North and of Wales has been unfavourably affected by the economic depression. Excessive mortality these areas certainly have, both when compared with England and Wales as a whole and with other sections of the country, but this excess is not peculiar to the years of depression; it has been a consistent feature of the depressed areas for at least the past twenty years. It is possible that there are a few exceptions to this general conclusion, and in Merthyr-Tydfil the mortality experience in respect of tuberculosis presents grounds for misgiving, but the evidence as a whole is strong testimony of the success of national and local efforts to mitigate evils of great magnitude.

Rural School Hygiene in France

L. FAURE-MURET (*Thèse de Paris*, No. 276; 1938) states that the organization of rural school hygiene in France is practically dependent upon the local authorities, especially as regards financial support. Much more attention, therefore, is given to the subject of school hygiene in large urban communities than in country districts. At the present day, the rural school in France is very much behind the times as regards progress in hygiene. The buildings are often in a state of decay and without proper sanitary annexes. The health of the school child is not properly cared for, and instruction in the theory of hygiene is quite inadequate. In certain country districts medical inspection scarcely exists, and even when it is provided, the medical man is not properly supplied with what he requires. M. Faure-Muret maintains that school hygiene should assume a far more important place in rural areas than in towns, as the conditions of life in the country, in spite of a certain number of favourable natural conditions, are inferior to those of life in towns. Urgent measures are needed for the benefit of the race.

Garden Plants from Equatorial East Africa

ENGLISH gardens owe much of their present floral beauty to plants of other geographical regions, brought by botanical explorers. It is perhaps rather surprising that the flora of high mountains in equatorial East Africa has as yet made no such contribution to European horticulture. Mr. Patrick M. Synge has shown, moreover (*J. Roy. Hort. Soc.*, 63, Pt. 10, Oct. 1938) that many plants of this region are also found in the English flora. It is therefore to be expected that the more striking indigenous flowering plants of Ruwenzori, the "Mountains of the Moon", and Mt. Eglon, might prove amenable to cultivation in our more temperate latitudes. Mr. Synge indicates some of the more promising of these; species of giant *Lobelia*, arborescent *Senecio*, *Helichrysum* (everlasting), *Impatiens*, *Hypericum*, *Kniphofia*, and others. Some species, as *Kniphofia Snowdenii*, are already to be found in the catalogues of enterprising nurserymen, and Mr. Synge's illustrations give potent promise of many other striking plants.

The Physical Society's Annual Exhibition

THE Catalogue of the twenty-ninth Annual Exhibition of Scientific Instruments and Apparatus held at the Imperial College of Science and Technology on January 3, 4 and 5 by the Physical Society covers 241 pages, 187 of which are devoted to trade exhibits, and 37 to research and educational exhibits (1 Lowther Gardens, S.W. 7. 1*s.*6*d.*). The two discourses were delivered in the large lecture theatre, on January 3 by Dr. J. D. Cockcroft on "The Cyclotron", and on January 4 by Mr. C. S. Wright on "Polar Geophysical Research". The number of firms exhibiting is slightly larger than last year, but the research and educational section is somewhat less. In the trade section the name of the firm and the number of the stand are given at the head of each page, and the index gives under each

instrument mentioned the pages on which descriptions of such instruments will be found. Some of the illustrations are not very informative, while others show internal details by cutting away enclosures, and a few give wiring diagrams.

Archæological Investigations in Turkey

A REPORT of results of the continued excavations of the Neilson Expedition to Turkey of the University of Liverpool on the site at Mersin in Southern Turkey, records the discovery of the remains of a fortified city, of which the architectural structure is remarkable (*The Times*, January 3). The gateway is flanked by towers; and a defensive wall is pierced by a range of narrow windows. Piles of improvised missiles lie at hand. The whole city was destroyed by fire while still in occupation; and the contents of the buildings, which include a palace, are said to be complete, though much burned by fire and broken. These remains were encountered at a depth of twenty feet below those of the Hittite city brought to light by the expedition last year. They are assigned to a date at about 3600 B.C.

Earthquake near Japan

THE U.S. Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of November 22, 1938, 1 h. 14·1 m. G.C.T., and finds it to be situated in latitude 37° N., longitude 142° E. This was made possible by reports from the seismological stations at Honolulu, Manila, Zikawei, Victoria, Georgetown, Fordham, Sitka and Philadelphia. This epicentre is under the bed of the ocean to the north-east of the main island of Japan, and is near the epicentres of the shocks of November 5 and 6, which were lat. 38° N., long. 141° E., and lat. 36° N., long. 144° E. respectively.

Earthquake in Belgium

THERE was an earthquake during the evening of December 30, with epicentre in the vicinity of Spixhe, near Spa, which caused the collapse of chimneys and moved furniture but caused no casualties. This recalls the earthquake of June 11, 1938, which probably had an epicentre somewhat to the north-west of the present one, and was felt in England, France, and Germany as well as in Belgium (NATURE, 141, 1090; 1938). The other epicentre near the present one was located in the International Seismological Summary as lat. 51° N., long. 6° E., which is to the north-north-east of the Spixhe shock and just inside the borders of Germany. Earthquakes occurred from the German epicentre on January 5, 1926, and January 14, 1928.

Announcements

WE regret to announce the deaths of Mr. Emile Mond, honorary treasurer of the Chemical Society and of the Faraday Society, on January 1, aged seventy-three years; and of Prof. Victor Grégoire, professor of botany in the University of Louvain, on December 12, aged sixty-eight years.

PROF. EJNAR HERTZSPRUNG, director of the Observatory and professor of astrophysics in the University of Leyden, has been elected *correspondant* of the Section of Astronomy of the Paris Academy of Sciences in succession to the late Dr. W. W. Campbell.

AMONG the recent medal awards of the Royal Horticultural Society are the following: Victoria Medal of Honour to Dr. W. F. Bewley, Mr. H. R. Darlington, Mr. F. G. Preston, and Mr. G. Reuthe; Veitch Memorial Gold Medals to Mr. M. B. Crane and Miss I. Preston.

A CENTRE for aeronautical studies and research has recently been founded at Milan by the Italian Ministry of Aeronautics.

THE University of Porto Alegre, with the support of the Federal Government of Brazil, has decided to erect a hospital including a pathological institute.

THE Cornell University Medical College, New York, has received from the Jane Coffin Childs Fund for Medical Research the sum of 4,500 dollars for experimental investigations of leukæmia with special reference to extra-chromosomal factors. The research will be carried out by Drs. C. L. Opie and J. Furth, of the Department of Pathology.

THE Government Health Service of the Dutch East Indies has instituted an investigation among medical practitioners as to their experience with medicinal plants. This will be carried on at the same time that the Commission on the Commerce of Medicinal Herbs is conducting a botanical and pharmacological analysis and a series of technical experiments in the cultivation of such plants.

THE Hellenic Travellers' Club has arranged a tour on March 18–April 7 to sites of medical interest in Greece. At Epidaurus, Prof. G. E. Gask will lecture on the cult of Æsculapius, and visits will also be paid to Cos, where the school of Hippocrates flourished, Cnidos, Pergamos, the home of the school of Galen, Athens and Mycenæ. Further information can be had from the Secretary, 3 Albany Courtyard, Piccadilly, W.1.

THE Royal Academy of Sciences of Turin announces that the thirty-first award of the Bressa Foundation Prize will be made during 1941. The prize, of the value of 9,000 lire, will be awarded to the man of science, either Italian or foreign, who, in the opinion of the Academy, shall have made the most notable and useful discovery or produced the most important work during the period 1937–41 in any of the following branches of science: physical and experimental science, natural sciences, pure and applied mathematics, chemistry, physiology, pathology, geology, history, geography and statistics. Authors who wish to have their work considered are invited to send copies, which must be printed, to the secretary of the Academy, Via Maria Vittorio 3, Turin, not later than January 31, 1941.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 29.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Estimation of Vitamin A

EARLY in 1937, the results of biological and spectroscopic tests for the vitamin A content of a specimen of halibut liver oil and of a concentrate prepared from it were published in NATURE[1]. Ten laboratories participated in this co-operative experiment. It was hoped that by enlisting so many groups of workers the uncertainty of the biological results, due to the error inherent in the biological technique, would be minimized, and that an authoritative pronouncement could be made on the magnitude of the value for the conversion factor relating the results obtained by spectrophotometric and biological methods. As a result, a value of 1,470 was reported for the halibut liver oil, whilst that for the concentrate was lower, lying between 1,000 and 1,200. Spectroscopic control carried out on the materials distributed for the feeding tests indicated a satisfactory degree of stability for the *oil*, but the *concentrate* deteriorated during the period occupied in the work by an amount sufficient to account for the lower value.

The value 1,470 then communicated as the conversion factor for the sample of halibut liver oil was a provisional one, since the results had not been subjected to statistical analysis. Since then, the statistical analysis has been completed by Dr. J. O. Irwin, of the London School of Hygiene and Tropical Medicine, who gives the final figure for the conversion factor for this specimen of halibut liver oil as 1,570. This result, therefore, agrees remarkably well with the value 1,600 provisionally adopted by the Second International Conference on Vitamin Standardization (1934).

The experiment did not, however, dispose of discrepant but well-accredited results obtained in the course of independent attempts to redetermine the conversion factor. One very important instance was that of the United States Pharmacopœia reference cod liver oil, adopted as subsidiary international standard for vitamin A at the 1934 International Conference. The value reported in 1934 for this oil for $E^{1\%}_{1cm.}$ 328 mμ was 1·44, as determined from the average result of tests by four sets of individual workers, or 1·58 according to Morton and Edisbury (see ref. 2, Table IV, p. 30), who are responsible for the spectrophotometric estimations in the present experiment. The biological potency assigned to the oil at that time was 3,000 I.U. per gm., representing the average of results collected from nine different laboratories by Dr. E. M. Nelson. The individual values ranged from 2,400 to 3,725 I.U. per gm. (ref. 2, p. 38). The conversion factor for this oil at that time was therefore 2,080 or 1,900, according to the value accepted for the contemporary spectrophotometric estimation. Materials tested against this oil have also tended to show high conversion factors of about 2,000; it seemed essential, therefore, that this oil should be subjected to another co-operative test.

A fresh sample of the oil was kindly contributed by the Committee of Revision of the U.S. Pharmacopœia, and tests similar to those described for the previous experiment[1] were made. The same precautions were taken to secure uniformity in dilution, and spectroscopic criteria were used to check the stability of the solutions used for the biological experiments. A special dilution of the international β-carotene standard was prepared, as before, by the Department of Biological Standards of the National Institute for Medical Research. The dilution of the U.S.P. reference oil was made by Dr. R. A. Morton and Dr. J. R. Edisbury of the University of Liverpool, who also made all the spectrophotometric tests.

Ten laboratories took part in the biological tests. The stability of the solutions used for the biological tests was satisfactorily maintained throughout.

The biological values obtained by the individual laboratories were submitted for statistical examination to Dr. J. O. Irwin, who reported that they ranged from 1,334 to 3,270 I.U. of vitamin A per gm.; six of the ten values lay between 2,200 and 2,600 I.U. per gm. and the weighted mean was 2,619 I.U. per gm. The mean limits of error per experiment ($P = 0{\cdot}99$) were 73 to 137 per cent.

The value of $E^{1\%}_{1cm.}$ 328 mμ for the unsaponifiable fraction of this particular sample of the U.S.P. reference oil was 1·44. The conversion factor, as determined in this test, is therefore 1,820.

If the result of this experiment is accepted, and the present biological potency for the U.S.P. oil is taken as 2,619 I.U. per gm. instead of the accepted 3,000 I.U. per gm., it is clear that the biological value of all substances tested against the U.S.P. oil for as long as it has possessed this value should be only 2,619/3,000 of that reported, and the conversion factor for each of such substances should be subject to a similar diminution. Even when this correction is applied, the conversion factor, as in the present case, may still be high.

A calculation has been made by Dr. Irwin which shows that the difference between the logarithms of the conversion factor of 1,570 for the halibut liver oil, and of 1,820 for the U.S.P. oil is 2·1 times the standard error, and that the odds are about 30 to 1 against this result being a chance difference. Before a final decision can be reached it will probably be necessary to carry out a third co-operative experiment when a pure vitamin A ester becomes available. Meanwhile, there seems no other course open than to recommend the continuation of the provisional value 1,600 as the best compromise, and again to await further data.

Those who participated in the work were: A. L. Bacharach and E. Lester Smith, Glaxo Laboratories, Ltd., Greenford; R. G. Booth, British Cod Liver Oil Producers (Hull), Ltd.; W. A. Broom, Messrs. Boots Pure Drug Co., Ltd., Nottingham; H. M. Bruce and K. H. Coward, Pharmaceutical Society, London; A. D. Emmett, R. A. Brown and M. Sturtevant, Messrs. Parke, Davis and Co., Detroit Laboratories (communicated by J. A. Freeman); E. M. Hume, Lister Institute, London; J. O. Irwin, London School of Hygiene and Tropical Medicine; S. K. Kon, National Institute for Research in Dairying, Shinfield; T. Moore, Dunn Nutritional Laboratory, Cambridge; R. A. Morton and J. R. Edisbury, University, Liverpool; S. W. F. Underhill, Messrs. The British Drug Houses, Ltd., London; H. Wilkinson, Messrs. Lever Bros., Ltd., Port Sunlight.

E. M. HUME

(Secretary, Vitamin A Sub-Committee of Accessory Food Factors Committee, appointed by the Lister Institute and Medical Research Council).

Lister Institute,
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Dec., 15.

[1] NATURE, 139, 467 (1937).
[2] Med. Res. Council, Special Report Series No. 202 (1935).

A Rapid Visual Test for Vitamin A Deficiency

THE recovery of vision after blinding by a bright light depends, among other things, on a reformation of visual purple from vitamin A in the blood. Various instruments have been used to test this relationship, but have been severely criticized. In all such work, at least fifteen minutes have been needed for each test, and usually much longer.

A new apparatus has been devised to test vitamin A deficiency rapidly. After looking at a bright light of certain intensity for 30 seconds, the time needed to see a dim light of constant intensity is taken (in distinction to instruments which have complicated means for varying the intensity of the dim light). The range of recovery times is 3–50 seconds, an average test takes less than a minute, and two or three tests are made within five minutes of the subject entering the room. Up to forty persons an hour have been tested.

Treatment with vitamin A of 123 people having more than fifteen seconds recovery time (taken as deficient), showed a response in all cases but three, ending in a recovery time of ten seconds or less (taken as normal). Thirty other cases treated with an A-free oil showed no change on repeated tests.

A normal person beginning at eight seconds placed on an A-deficient diet gradually lengthened in recovery time until a time of twenty-seven seconds was reached. At this point hæmeralopia, asialia and other symptoms of A-deficiency were present.

Normal recovery time on this apparatus is considered to be ten seconds or less, and over fifteen seconds is deficient. These somewhat arbitrary times were arrived at in the following way: (1) An early survey of a hundred people was plotted to show the number of cases at each recovery time. The form of this curve is the same with our present total of 1,200 cases. The mode is eight seconds, and there is a pronounced dip at 11 seconds. All values less than eleven seconds were therefore tentatively adopted as normal. (2) Large amounts of vitamin A have no effect on recovery times already at ten or less; but recovery times at twelve or twenty or more, treated with vitamin A come to values of ten or less, depending on the individual.

In a survey of a thousand university students, 52 per cent were normal (3–10 sec.), 24 per cent border-line (11–15 sec.), and 24 per cent deficient (16 or more) with respect to vitamin A.

From these students, 753 case histories were obtained, and the following are some of the relationships found:

	Normal (per cent)	Border-line (per cent)	Deficient (per cent)
Cold within a month after test	54·5	64	71·5
Night blindness	7	18	19
Dry skin	7	16	18

A total of 1,200 people have been tested and no relation has been found to sex, age, colour of eyes, wearing of glasses if usually worn, myopia, hypermetropia, astigmatism or fatigue. These and other factors are still being investigated. On the other hand, every deficient case has been found to have had a low intake of vitamin A (where calculated this has ranged from 500 to 2,000 I. U. daily).

Full details of the apparatus, and of these investigations, will be published elsewhere.

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Nov. 25.

Laccase, a Blue Copper-Protein Oxidase from the Latex of *Rhus succedanea*

IN 1883 Yoshida[1] discovered, in the latex of the Japanese lacquer tree (*Rhus vernicifera*), a thermolabile substance which was responsible for the darkening and hardening of the lacquer.

To Bertrand[2] we owe the first extensive study of this substance which he found in the latex of an Indo-Chinese lacquer tree (*Rhus succedanea*). He described this substance under the name of laccase, and showed it to be an enzyme capable of catalysing the oxidation of different polyphenols such as hydroquinone, pyrogallol and others. He has also shown that the darkening and hardening of latex is due to the catalytic oxidation by this oxidase of natural polyphenols, urushiol and laccol. This important discovery of Bertrand was confirmed and extended by other workers and more recently by Suminokura[3] and Brooks[4].

The laccase for our present study was obtained from the latex of *Rhus succedanea*. For the extraction and purification of the enzyme the latex is treated with acetone, the precipitate is dried, extracted with water and the enzyme is then purified by a method somewhat similar to that used by us for purification of polyphenol oxidase of mushrooms[5].

The purified enzyme catalyses the oxidation of polyphenols and diamines, the oxidation of *p*-phenylenediamine being twice as fast as that of catechol. Monophenols such as *p*-cresol or tyrosine are not oxidized at all by purified laccase even when tested for ninety minutes. Both crude and partly purified enzymes catalyse the oxidation of asorbic acid without the addition of a carrier such as catechol.

The purest enzyme preparation obtained has a strong blue colour. It is devoid of hæmatin, iron and

manganese, and contains 0·154 per cent copper. The colour of laccase solution containing 0·015 mgm. copper per c.c. is of the same intensity as a 7 per cent copper sulphate solution. The colour disappears reversibly on the addition of a very small amount of substrate such as ascorbic acid or hydroquinone. It also disappears on boiling the enzyme or treating it with cyanide and diethyl-dithio-carbamate.

The activities of different preparations are proportional to their copper contents. All this shows that laccase is a copper-protein compound belonging to the same group of enzymes as the polyphenol oxidase of potatoes[6] and of mushrooms[5]. If the polyphenol oxidase of mushrooms containing 0·3 per cent copper is 90–100 per cent pure, the laccase preparation containing 0·154 per cent copper would be 45–50 per cent pure. This laccase preparation, however, contains 55 per cent of a polysaccharide and only 6·45 per cent nitrogen, which corresponds to about 45 per cent protein. Assuming now that the polysaccharide is an impurity not connected with the enzyme and the copper is bound only to the protein, the copper content of the laccase protein would be about 0·34 per cent, which is the same as the copper content of crystalline hæmocuprein[7]. If one allows for the polysaccharide content of our purest preparation, the Q_{O_2} of pure laccase would appear to be about 40,000 with *p*-phenylenediamine as substrate at 20° C.

The activity of laccase is strongly inhibited by potassium cyanide, hydrogen sulphide, sodium azide and diethyl-dithio-carbamate but not by carbon monoxide, and this holds true whether catechol, *p*-phenylenediamine or ascorbic acid are used as substrates.

Although laccase belongs to the group of copper-protein enzymes, it differs in the following respects from the polyphenol oxidase of cultivated mushrooms (*Pealiota campestris*):

(1) Laccase is distinctly blue while polyphenol oxidase is yellowish or colourless.

(2) Laccase oxidizes *p*-phenylenediamine better than catechol, while polyphenol oxidase scarcely attacks it.

(3) Laccase, when pure, does not oxidize *p*-cresol at all, while polyphenol oxidase in this reaction shows a distinct lag period, which, as we have shown, becomes more protracted on gradual purification of this enzyme[5].

(4) Crude laccase preparation oxidizes ascorbic acid directly; this activity decreases on purification and can partly be restored by the addition of catalytic amount of *p*-phenylenediamine but not of catechol. Polyphenol oxidase, on the other hand, whether crude or pure, oxidizes ascorbic acid only through a carrier like catechol. The Q_{O_2} of this latter reaction using only 0·02 mgm. catechol is still very large (540,000)[5].

(5) Laccase is not poisoned by carbon monoxide, while polyphenol oxidase, as we have shown, undergoes a very strong, although light-insensitive, inhibition by carbon monoxide[5,8].

(6) The activity of laccase ($Q_{O_2} = 40,000$) is of the same order of magnitude as that given for potato oxidase[6]. Both enzymes show only a twentieth of the activity of the polyphenol oxidase from cultivated mushrooms. This is clearly demonstrated especially when the activities of laccase and mushroom oxidase are estimated in the same way.

It may be mentioned that the purification of polyphenol oxidase from a wild mushroom (*Lactarius vellereus*) gave a yellowish preparation containing 0·2 per cent copper and having Q_{O_2} of about 250,000 for catechol and of only 1,640 for *p*-phenylenediamine.

The results of this communication, apart from the fact that they reveal the nature and properties of laccase, are interesting in some other respects. They dispose of the criticism of our work on the polyphenol oxidase of mushrooms made by Kubowitz[9] who, without justification, assumes that the properties of different plant phenol oxidases must be the same as those of the potato oxidase. These results also serve as a warning against generalizations based on an incomplete knowledge of the subject and against the tendency of ascribing to one enzyme the properties of another enzyme in the same class, contrary to all the available evidence.

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Dec. 7.

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[2] Bertrand, G., *C.R.*, **118**, 1215 (1894).
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The Sympathetic Character of the Nucleus Supraopticus

IN a recent publication dealing with the question of whether nerve fibre terminals or pituicytes in the pars nervosa of the pituitary secrete the hormones pitocin and pitressin[1], I quoted Ranson, Kabat and Magoun[2] as holding the view that the nucleus supraopticus of the hypothalamus was sympathetic in character. I was under the impression that the hypothalamic sympathetic centre, which extends to the chiasm, also included the nucleus supraopticus. On re-reading their work, it was found that a small paragraph had been overlooked in which it is definitely stated that there was no evidence that the nucleus supraopticus was included in this sympathetic centre.

I apologize to these authors for this error and retract the above-mentioned quotation. However, other evidence quoted (Kappers[3]) indicates that the nucleus supraopticus is sympathetic. Crouch and Elliott[4] found that sympathetic reactions were regulated by the hypothalmus as a whole; but better responses were obtained from anterior and lateral nuclei. Because of this, I think that the nerve terminals of the hypothalamicohypophyseal tract are either adrenergic or cholinergic, as are the terminals of other autonomic fibres, and do not secrete the characteristic nervosa hormones.

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Dec. 3.

[1] Griffiths, *Proc. Linn. Soc. N.S.W.*, **63**, pts. 3–4, 81 (1938).
[2] Ranson, Kabat and Magoun, *Arch. Neurol. and Psychiat.*, **33**, 467 (1935).
[3] Kappers, "Three Lectures on Neurobiotaxis and other Subjects" (William Heinemann (Medical Books), Ltd., 1928).
[4] Crouch and Elliott, *Amer. J. Physiol.*, **115**, 245 (1936)

Heteroauxin Production by Efficient and Inefficient Strains of *Rhizobia*

IT has been suggested by Thimann[1], Link, Wilcox and Link[2], and Link[3] that β-indole-acetic acid (heteroauxin) is the agent partially or entirely responsible for the formation of nodules on the roots of leguminous plants. Thimann[1] advances the hypothesis that the root nodule bacteria convert tryptophane into heteroauxin, (*a*) by stimulating elongation of a lateral root and (*b*) by arresting root elongation through continued auxin production, resulting in the formation of a nodule. If this condition exists, there may be differences in the rate of formation and in total amounts of heteroauxin derived from tryptophane, between efficient and inefficient strains of *Rhizobia*. (Efficient: *Rhizobia* which infect the host plant and benefit the latter by the symbiosis; inefficient: *Rhizobia* which infect the host plant but fail to aid in fixing atmospheric nitrogen.) Nodules produced by efficient strains are generally characterized as being large and usually located on the crown of the tap-root, indicating early invasion, while inefficient strains produce very small nodules which are distributed over the secondary root system, indicative of relatively late invasion.

The purpose of these investigations was to determine whether or not early or late invasion could be correlated with rate and amount of production of β-indole-acetic acid. The substrate upon which the *Rhizobia* were grown consisted of mannitol 1·0 per cent, K_2HPO_4 0·05 per cent, $MgSO_4$ 0·02 per cent, NaCl 0·01 per cent, $CaCO_3$ 0·1 per cent, KNO_3 0·05 per cent and tryptophane ('Pfanstiehl') 0·05 per cent. In contrast to Chen's medium[4], in which yeast extract was the source of nitrogen, the above medium contained inorganic nitrogen. No β-indole-acetic acid could be detected in uninoculated controls. Neither could heteroauxin be detected in ether extracts of cultures inoculated in the basal media (same as above with tryptophane omitted), indicating that the bacteria were unable to synthesize the auxin when potassium nitrate was used as a nitrogen source and mannitol as a carbon source.

The basal medium was sterilized at 15 lb. pressure for 15 minutes and a solution of tryptophane, sterilized by filtration, added aseptically. Preliminary tests in which 'tryptone' ('Bacto') or peptone ('Bacto') plus 'tryptone' was substituted for tryptophane, yielded data similar to those in the accompanying table, with the exception that the uninoculated controls frequently yielded positive tests for heteroauxin. Therefore, the medium cited above was used exclusively.

FINAL CONCENTRATION OF β-INDOLE-ACETIC ACID IN 5 ML. MEDIUM AFTER FOUR WEEKS (AVERAGE OF FOUR EXPERIMENTS).

	Efficient	Inefficient	
Rh. meliloti	1 : 75,000	1 : 10,000	
Rh. trifolii	1 : 42,000 (*R*)	1 : 75,000	
Rh. leguminosarum	1 : 42,000	1 : 45,000 (*R*)	
Rh. phaseoli	1 : 52,000	1 : 42,000 (*R*)	
B. radiobacter			1 : 10,000 (24 hr.)
Controls (uninoculated)	0	0	

(*R*) indicates cultures which brought about a rapid conversion.

Cultures were incubated at room temperature for four or five weeks. Presence of heteroauxin was first detected by the *Avena* technique, but later a colorimetric method[5,6] was employed to test for indole-acetic acid. Cultures were tested three times weekly, during the course of each experiment, by withdrawing aliquots aseptically. Subcultures into litmus milk at periodic intervals failed to reveal any contamination. The strains studied were *Rh. meliloti* cultures 107 (efficient) and 120 (inefficient), *Rh. trifolii* 202 (inefficient) and 209 (efficient), *Rh. leguminosarum* 317 (efficient) and 333 (inefficient) and *Rh. phaseoli* 403 (inefficient) and 414 (efficient)*.

B. radiobacter, commonly found in the root nodules of the Leguminosæ, transformed tryptophane into β-indole-acetic acid at a more rapid rate than the *Rhizobia*, yet this organism does not produce nodules on the roots of legumes.

From the data cited, there is no apparent correlation between the rate and amount of indole-acetic acid derived from tryptophane and the ability to fix atmospheric nitrogen by the strains of *Rhizobia* studied. In fact, there is a tendency for the inefficient to produce auxin more rapidly than the efficient strains. Chen[4] reports that ineffective strains in most of his experiments produced less growth substance than effective ones. He used *Rh. trifolii* only, and our data substantiate his in this respect but not when *Rhizobia* of other cross inoculation groups were studied. The fact that *B. radiobacter* likewise produces heteroauxin further complicates any interpretation of the data. What significance, if any, can be attached to the production of β-indole-acetic acid by *Rhizobia* in the light of the behaviour of *B. radiobacter*?

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Nov. 18.

* Culture numbers refer to the University of Wisconsin strains obtained originally through the courtesy of Messrs. Sarles and Baldwin.

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Fossil Man-Apes of South Africa

BY invitation from Dr. Robert Broom, of the Transvaal Museum, Pretoria, and from Prof. Raymond A. Dart, of the Medical School, University of the Witwatersrand, Johannesburg, we visited South Africa in July and August last, and were given every facility for the study of the original fossils described as *Australopithecus africanus* Dart, 1925[1], *Australopithecus* (later *Plesianthropus*) *transvaalensis* Broom, 1936[2], and *Paranthropus robustus* Broom, 1938[3], all probably of Pleistocene age.

Our report on the dentition and dental arches of the South African fossil man-apes has recently been completed and sent to the Pretoria Museum, but the importance of these 'near-men' in future discussions of the origin of man seems to warrant the present brief statement of our principal results.

The dentition of the adult forms described by Broom presents many transitional or annectant conditions between the pithecoid and human stages. The upper canine tooth in a supposed female specimen referred to *Plesianthropus transvaalensis* has a smaller transverse diameter than the first upper premolar, and is altogether more human than ape-like. Although the upper canine crowns are broken off in the type specimen, the roots prove that these teeth were much smaller than those of apes. A well-preserved lower canine found in the same cave (at Sterkfontein) is remarkably small in comparison with those of typical modern apes; its crown has a

relatively low tip. This form of canine, which is sometimes nearly approached in certain female chimpanzees and orangs, would require but little additional modification to attain the human status.

The first upper premolar of *Plesianthropus* differs from that of typical apes in having a nearly symmetrical convex outer face and a generally human appearance; however, its buccal root remains distinct from the lingual, as in apes.

a gradual shift from the frugivorous food habits of primitive dryopithecine apes to the omnivorous habits of early man.

The facts and considerations cited in our fuller report can scarcely leave a well-founded doubt that the Pleistocene man-apes were survivors of the diversified *Dryopithecus* stock of the late Tertiary, which ranged from Spain to India and southward to East Africa, and that they were, in both a structural

A B C

RESTORED UPPER DENTAL ARCHES OF (A) *Sivapithecus sivalensis*, (B) *Plesianthropus transvaalensis*, (C) HEIDELBERG. (C) RESTORED BY PROF. J. H. MCGREGOR TO FIT THE KNOWN LOWER DENTAL ARCH.

The first lower premolar of *Paranthropus* has a rounded or ovoid crown, not unlike that of *Sinanthropus* and far advanced beyond the primitive condition in the lower Miocene *Proconsul*; here the first lower premolar has a compressed crown, the outer face shearing against the inner face of the upper canine. Transitional stages leading to the almost human first premolar of *Plesianthropus* are seen in the Siwaliks forms *Sivapithecus sivalensis* and *S. indicus*. With regard to its second lower premolar, *Plesianthropus* is intermediate between *Sivapithecus* and *Sinanthropus*.

The first and second upper molars of *Plesianthropus* are of the four-cusped type common to apes and man, but m^2 in the South African genera is very large, and even m^3 is much larger than in most men; moreover, m^1 is the smallest of the three. In the lower molars the length increases as we pass from m_1 to m_3 as it does in primitive apes, whereas in man m_3 is usually shorter anteroposteriorly than m_1. The lower molars of *Plesianthropus* exhibit a modified form of the five-cusped '*Dryopithecus* pattern'; but the principal grooves tend to arrange themselves as in the 'plus pattern' of typical man; cusp 6, which is barely indicated in some apes, is here prominent, as it is in some men.

A critical consideration of the evidence has led to the reconstruction of the upper dental arch reproduced in the accompanying figure. Its sides were slightly divergent posteriorly and it was well advanced in the human direction.

The crowns of the lower grinding teeth of the South African man-apes when well worn present nearly flat surfaces, as in man, whereas those of apes show steep elevations, especially on the inner side. These transitional conditions suggest that there was and a genetic sense, the cousins of the contemporary human branch. Their numerous transitional conditions tend strongly to connect the families of apes and men at no very distant geological date (perhaps lower Pliocene). They seem to give no support to the idea of the separate existence of the human stock in early Tertiary times.

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MILO HELLMAN.
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Dec. 3.

[1] NATURE, 115, 195–199 (Feb. 7, 1925).
[2] NATURE, 138, 486–488 (Sept. 19, 1936).
[3] NATURE, 142, 377–379 (August 27, 1938).

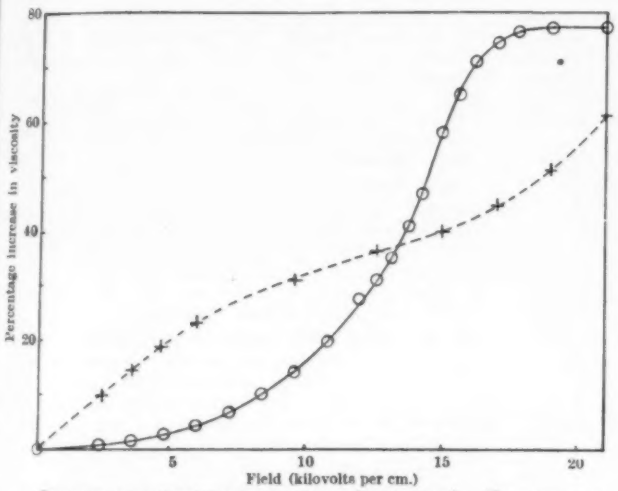
Effect of an Electric Field on the Viscosity of Liquids

FOR the past three years we have been working on the effect of an electric field on the viscosity of liquids. As the subject is now attracting attention, we think it will be well to give a preliminary account of our chief results. Experiments have been carried out with a method that permits a high degree of accuracy, with fields both transverse to and parallel to the direction of flow. The transverse field was applied with the liquid running in a channel of rectangular cross-section, the distance between the opposite charged sides, which were parallel to a high degree of accuracy, being about 0·2 mm.

The liquids used may be classified into those possessing no dipole moment, and those with a dipole moment. With non-polar liquids there is no effect. For example, with carbon disulphide and a transverse

field of 40,000 volts/cm., we have shown that any change in viscosity must be less than 1 part in 5,000. Other substances for which no effect has been established are benzene, chlorbenzene and various alcohols.

A marked effect, which presents several striking features, has been established with ten polar liquids (ether, acetonitrile, acetone, nitromethane, chloroform, and methyl, ethyl, propyl, butyl and amyl acetates). The viscosity increases with the field, but shows a saturation effect. A typical curve of the relation between field and change of viscosity is reproduced herewith for acetonitrile. The viscosity increases at first in a way roughly proportional to the square of the field, but later approaches a constant value which we call η_s. In the case illustrated the limiting increase of viscosity is nearly 80 per cent.



CHANGE OF VISCOSITY WITH FIELD (FULL LINE). BROKEN LINE SHOWS CURRENT, IN ARBITRARY UNITS, AT DIFFERENT FIELDS

With any one polar liquid the scale of the increase, determined by the value of η_s, depends markedly on the purity, as measured by the conductivity k of the liquid. Repeated distillation diminishes both k and η_s and it has been established that η_s is proportional to k. For example, with acetonitrile the limiting increases of viscosity are 115 per cent and 27 per cent for conductivities of $2{\cdot}58 \times 10^{-6}$ and $0{\cdot}578 \times 10^{-6}$ ohm^{-1} cm.$^{-1}$ respectively.

In transverse alternating fields, the full static effect is obtained up to frequencies of about 400 $\sim$. With higher frequencies, the effect decreases, and at frequencies of the order of 2,000 $\sim$ there is no change of viscosity. The cut-off frequency increases as the temperature rises. No effect has been obtained in longitudinal fields of the same order.

An interesting effect which has been established is that the current through these badly conducting polar liquids (k of the order 10^{-6} ohm^{-1} cm.$^{-1}$) does not obey Ohm's law. The current has certainly ceased to be proportional to the potential difference at fields of the order of 2,500 volts/cm., and tends towards a saturation effect. At higher fields there is a rapid rise in current, the whole curve of current against voltage being reminiscent of that for an ionized gas. The broken curve reproduced is typical.

The implications of these results will be discussed in a paper which awaits the completion of confirmatory results with a channel of different width.

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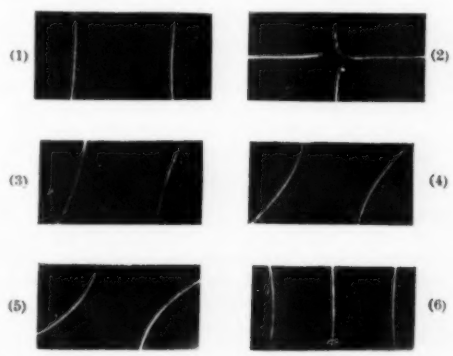
Fundamental Vibration of a Rectangular Plate

THE *higher overtones* of vibrating plates sometimes combine when it so happens that the periods of two or more of them are very nearly equal. This phenomenon, which is of academic rather than of applied interest, has been fully studied for a free circular plate[1].

That the *graver tones* of the transverse vibrations may occasionally combine, would appear to be of importance in engineering resonance problems; the rectangular plate is a case in point. Two familiar sand nodal figures are shown in Figs. 1 and 2, of which the first is fundamental to a narrow, and the second is fundamental to a wide free rectangular plate. The frequencies for the particular brass plate employed were very nearly equal, 558 and 548·8 c./sec. respectively. By filing the longer side of the plate, the two periods were adjusted to equality with the aid of a valve oscillator. This resulted in a profound change in the form of the vibrating surface (see Fig. 4), the former nodal systems being no longer obtainable. A pattern which is the mirror image of Fig. 4 can also be obtained. The sharpness of resonance, which is an inverse measure of the 'damping capacity' of engineering practice, is considerable. Thus a change of only 1 c./sec. one way or the other in the tone, produced the modified nodal patterns of Figs. 3 and 5.

That these curved nodal lines are due, neither to a want of uniformity in the plate, nor to absence of



freedom in the vibration, is proved by the fact that as soon as the same plate is excited in another mode (see Fig. 6), a characteristic single nodal pattern is

obtained. The ratio of length to breadth in Fig. 4 is 1·93. I estimate that a combination between the nodal systems of Figs. 2 and 6 should occur when this ratio is about 3·9.

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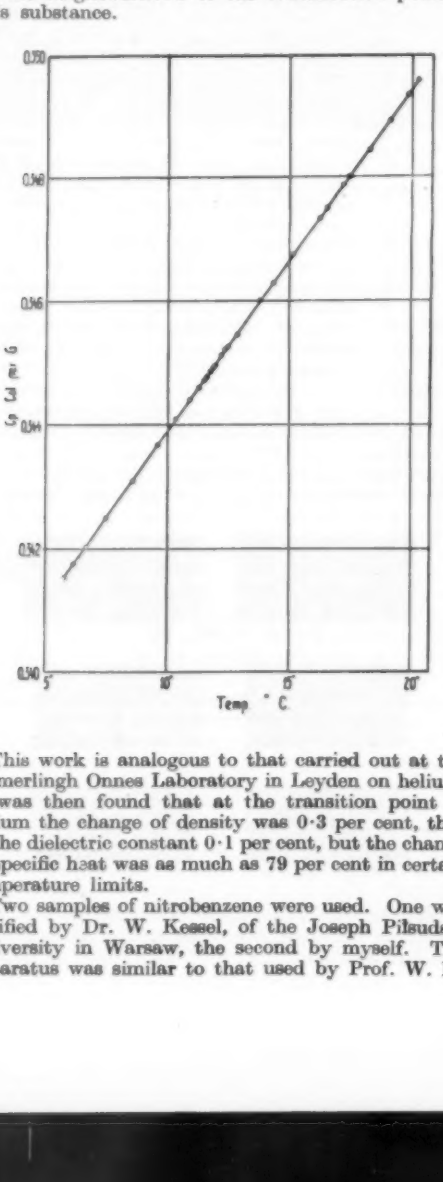
Dec. 5.

[1] Waller, M. D., *Proc. Phys. Soc.*, **50**, 77 (1938).

Relation between Specific Heat and Temperature for Nitrobenzene

THEORETICAL considerations lead to the conclusion that traces of impurities can have an influence on the dielectric constant and density of a substance, but the changes of energy are only very slightly affected by them. For these reasons, the relation between specific heat and temperature for nitrobenzene has been investigated, with special attention to the neighbourhood of the solidification point of this substance.



This work is analogous to that carried out at the Kamerlingh Onnes Laboratory in Leyden on helium. It was then found that at the transition point of helium the change of density was 0·3 per cent, that of the dielectric constant 0·1 per cent, but the change of specific heat was as much as 79 per cent in certain temperature limits.

Two samples of nitrobenzene were used. One was purified by Dr. W. Kessel, of the Joseph Pilsudski University in Warsaw, the second by myself. The apparatus was similar to that used by Prof. W. H. Keesom and Dr. Clusius[1] in Leyden. Before measurement, the nitrobenzene was distilled directly into the calorimeter. The energy increments were made small so as to be able to observe the possible transition point.

The experimental results show that the change of the specific heat of nitrobenzene with temperature is linear and this relation can be represented by the following equation:

$$C = 0{\cdot}33830 + 0{\cdot}000556\,t.$$

It should be emphasized that observations in the neighbourhood of 9·5° C. were made with especial care, the points of the curve being 0·3° C. from each other, all lying on a straight line. The results obtained are in perfect agreement with those of other authors[2], especially with the data of Williams and Daniels[3].

The relation of the refractive index to temperature and the heating curve were also investigated in the temperature limits 5·7–20° C., but no anomalous behaviour was observed.

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Nov. 16.

[1] Keesom, W. H., und Clusius, K., *Comm. Leiden*, No. 219.
[2] Parks, G. S., and Todd, S. S., *J. Chem. Phys.*, **2**, 440 (1934).
[3] Williams, J., and Daniels, F., *J. Amer. Chem. Soc.*, **46**, 903 (1924).

After-Image Phenomena

IF in a dark room a light be attached to a scale, and a point three feet on the right is marked with a peg and the light be looked at with one or both eyes for one or two seconds from a distance of ten feet and then the eyes be directed at the peg, it will be noticed that the negative after-image of the light is seen on the peg but the positive after-image has rapidly passed it to the right. The eyes being firmly directed towards the peg, it will be noticed that the positive after-image comes rapidly back towards the peg.

The first part of the experiment I have described before; it is evidently due to the contraction of the eye muscles pressing on the eye and moving the photo-chemical fluid, thus causing a separation of the positive and negative after-images. The second part of the experiment appears to be due to the cessation of the pressure on the eye causing the photo-chemical fluid to flow in the opposite direction. It should be noted that the pressure is in the opposite direction to the movement of the image; thus when the pressure is to the left, the image moves to the right, corresponding to the new position of the fluid in the retina.

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Ultra-Violet Spectrum of Thiophosgene

WE have tried to solve the problem of the fundamental vibrations of thiophosgene by analysing one of the three band systems found by one of us[1] previously in the ultra-violet spectrum of the vapour. The first system is composed of more than five hundred bands distributed between 5712 and 3989 A. at ordinary temperature. A second and a third

system appear between 3282 and 2710, and beyond 2710 A. respectively. Their complete analysis is in progress.

The main feature of the first system, observed when the dispersion is sufficiently high, is the fact that each band is resolved into two or sometimes three components. It is easy to see that we are dealing with isotope effects originating from the Cl atoms. As a matter of fact, the same phenomenon has already been observed by one of us[2] in the case of phosgene and has been assigned to the above cause through direct experiments by W. Kuhn[3].

The following formula enables us to calculate all the bands of the system in satisfactory agreement with the observed frequencies :

$$\nu = 17374 + 914v_1' - 3v_1'^2 + 240v_2' + 400v_3' - v_3'^2 - 1148v_1'' - 537v_2''.$$

Thus the absorption spectrum of thiophosgene is characterized by five fundamental frequencies : 1148 and 537 cm.$^{-1}$ for the normal molecule and 914, 240, 400 cm.$^{-1}$ for the activated state.

As the molecule belongs to the symmetry group C_{2v}, it is possible to assign these values to the various possible vibrations in the following way :

$\nu_1'' = 1148$, $\nu_2'' = 537$, $\nu_1' = 914$, $\nu_2' = 240$, $\nu_3' = 400$.[4]

The nomenclature is identical with that used by Bailey and Hale[5] in the case of phosgene.

It is worth mentioning that our analysis was made at a time when no data were available for the Raman or infra-red vibration frequencies of the thiophosgene molecule. Our formula has been derived from the measurements by determining the distribution of intensities, considering quantitatively the isotope effect and by applying the rules of Herzberg and Teller[6]. It is only recently that the Raman spectrum of liquid thiophosgene has been measured, namely, by H. W. Thompson[7]. His data confirm our results for the normal molecule both with regard to magnitude and assignment : $\nu_1'' = 1121$ and $\nu_2'' = 497$. The slight difference may be due partly to the fact that our figures refer to the gaseous and not to the liquid state of the thiophosgene molecule.

It is further of interest that even the values of $\nu_3'' = 287$ and $\nu_3'' = 363$ given by H. W. Thompson are not very different from our figures for ν_3' and ν_3, although these latter belong to the excited and not to the ground state as in Thompson's experiments. This coincidence is obviously due to the fact that the electron excitation is located in the C–S bond. Incidentally, with the elucidation of the thiophosgene spectrum, our experiments provide, as results of more general interest, a check on the validity of the Herzberg-Teller theory and a justification for the use of the isotope effects in the study of complex spectra.

Details of our experiments will be published elsewhere.

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Dec. 3.

[1] Henri, V., "Structure des Molécules", 90 (1925).
[2] Henri, V., and Howell, O., *Proc. Roy. Soc.*, **A**, **128**, 190 (1930).
[3] Kuhn, W., and Martin, H., *Z. phys. Chem.*, **21**, 93 (1933).
[4] Duchesne, J., Thèse Liège, 1937.
[5] Bailey and Hale, *Phil. Mag.*, **25**, 98 (1938).
[6] Herzberg and Teller, *Z. phys. Chem.*, **21**, 410 (1933).
[7] Thompson, H. W., *J. Chem. Phys.*, (ii), **6**, 748 (1938).

Points from Foregoing Letters

STATISTICAL analysis of the results obtained in ten laboratories give a value of 1,570 for the conversion factor for calculating from spectrophotometric observations the biological effect of halibut liver oil (containing vitamin A) ; therefore Miss E. M. Hume considers that the conversion factor of 1,600 provisionally adopted by the Second International Conference on Vitamin Standardization in 1934 should be retained, although marked discrepancies have been observed in the United States, in connexion with the United States Pharmacopœia reference cod liver oil, which gives a higher conversion factor (about 2600).

The time of recovery of vision after looking at a bright light has been determined by Dr. L. B. Pett for 1,200 people by means of a new apparatus and found to depend upon the amount of vitamin A taken with the food. The author also gives a table showing a certain correlation between recovery time in the visual test on one hand and dry skin, night blindness and liability to colds on the other.

Laccase, an oxidizing enzyme found in the latex of *Rhus succedanea*, is found by Prof. D. Keilin and Dr. T. Mann to be a copper-protein compound belonging to the same group as the polyphenol oxidase of potatoes and mushrooms, but differing in its blue colour and other respects ; for example, it oxidizes ascorbic acid directly, does not oxidize *p*-cresol and is not poisoned by carbon monoxide.

Dr. C. E. Georgi and A. E. Beguin find that there is no correlation between the amount of indole-acetic acid (heteroauxin) produced in synthetic media, in presence of tryptophane, by various strains of *Rhizobia*, and the ability of these strains to induce the formation of nodules on the roots of leguminous plants.

From a study of the dentition and dental arches of the South African fossil man-apes, Prof. W. K. Gregory and Dr. M. Hellman conclude that these Pleistocene man-apes were derived from apes at no very distant geologic date, perhaps Lower Pliocene, and that the evidence does not indicate the existence of human stock in early Tertiary times.

A graph showing the change in viscosity of acetonitrile under the influence of an electric field, is submitted by Prof. E. N. da C. Andrade and C. Dodd. Similar results were obtained with ether, acetone and other polar liquids ; with non-polar liquids there is no effect.

Nodal figures obtained with rectangular brass plates, showing that the *graver tones* of the transverse vibrations may occasionally combine, are submitted by Miss Mary D. Waller.

The change in the specific heat of specially purified nitrobenzene with temperature is found by Dr. J. Mazur to be linear over the range 5°–20° C.

The ultra-violet spectrum of thiophosgene has been investigated by Prof. V. Henri and Dr. J. Duchesne. The vibration frequencies calculated for the normal molecule agree with those since published by H. W. Thompson, derived from a study of the Raman spectrum.

Research Items

Kazak Social Structure

MR. ALFRED E. HUDSON has examined the nature of certain features of Turco-Mongol social structure, investigating the processes which appear to have been active in their development ("Kazak Social Structure", *Yale University Publications in Anthropology*, No. 20. Yale Univ. Press, and Humphrey Milford, 1938. Pp. 109. Price 1.50 dollars). Most of the material utilized relates to the middle nineteenth century, immediately before the Russian conquest of Central Asia; but the author also bases his work on investigations in the field in 1936. The Kazak, or Kirghiz, are a nomad stock-herding people, though now becoming sedentary. They inhabit the steppe country lying between the Caspian and the Altai Mountains, and number, according to the 1926 census, 3,959,000. They are divided into a large number of tribes, sub-tribes, gentes and branches, of which the structure and relation one to another are not clear. As the result of this investigation, after consideration of the various aspects of Kazak social life into which they enter, it would appear that there is a constant tendency towards the division of existing groups by branching, and at the same time a movement towards the formation of larger groups from the smaller by fusion. Although increasing numbers was the underlying cause of fission, the immediate causes were various. New economic units arose, for example, from the custom of giving a son a share of his father's cattle, favouring the centrifugal tendency. In the formation of larger units, groups of individuals, who belonged to other gentes, were absorbed, or subordinate or vassal gentes might be formed, leading to a symbiosis, rather than a political union. Political amalgamation frequently cut across genealogical lines. While some unions were for mutual protection, others were the result of force. In this third type it is difficult to distinguish between voluntary and involuntary amalgamation. The prestige of a leader acted as a magnet. In practice the solidarity of the blood-group was subservient to the domination of the wealthy and powerful individual. The personal dependence of the weak on the strong and wealthy was more effective than the responsibility of the members of the blood group for one another.

Petroglyphs and Tuareg Origins

IN 1926, the Hon. Francis Rodd directed attention to apparent similarities between certain rock drawings in the Aïr mountains of the southern Sahara and the pictures of Libyans in Egyptian tomb decorations, etc., of the Nineteenth and Twentieth Dynasties. The question of whether the Tamahu and Tehenu of the Egyptian records were related to, if not the actual ancestors of, the Tuareg, was discussed by Oric Bates. Mr. Rodd now points out (*J. Roy. Anthrop. Inst.*, 68; 1938) that the human figures which appear in these petroglyphs can be divided into categories, according to the method of portrayal. Four types can be distinguished: (1) The 'hour-glass' group, which recently has become explicable as represented in the archaic leather dress of the 'wild men, of the Ahaggar and Aïr, who live remotely in the fastnesses of these mountains, possibly remnants of a pre-Tuareg, non-negroid people; (2) the 'demon' or 'imp' figures, having nothing in common with the other groups except hair decoration; (3) decorated figures, with an elaborate dress, in which an attempt is made to portray a patterned or chequered garment with a yoke or ornament at the neck, and having certain analogies in Tehenu Libyans of the Egyptian tombs; and (4) the 'riding-breeches' group. Nos. 3 and 4 appear to be contemporary, though their heads are strikingly different in shape. It has been suggested that the 'riding-breeches' type represents the women of group 3. Neither type shows the mouth, which may be an attempt to represent the Tuareg veil, although the Egyptian Libyans have the mouth fully represented. Tentatively it is concluded that group 2 may be an aboriginal pastoral, or hunting people, slaves or subjects of group 1, that is if they are their contemporaries. Group 3 may be the Libyans of the Egyptian tombs. They wear feathers in their hair, with the Libyan lock on each side of the head. They possess spears and javelins, round shields and horses. Group 4 may be women or men. If the latter they are of a different race from Group 3; if they are women, they are the women of group 3, in which event they ought to be Amazons, as they wear feathers in their hair, one Libyan lock and possess spears, javelins, round shields, and horses. If group 3 represent the ancestors of the Tuareg, it shows the survival of the same costume over a very long period, and makes the migration of the Tuareg to Aïr much earlier than has been thought.

Antirabic Immunization

I. J. Kligler and H. Bernkopf (*Brit. J. Exp. Path.*, 19, 378) report experiments showing that intraperitoneal injection of formolized tissue cultures of rabies virus has considerable immunizing capacity for mice. Immunity to intracerebral infection was incomplete, and about 42 per cent showed no immunity after five to seven injections of the vaccine. Immunity was established more readily by intraperitoneal or subcutaneous infection. Immunized mice which survived an intraperitoneal infection were found to possess a greater degree of immunity than untreated mice which survived infection. Primary treatment with inactive virus affected in a marked degree the immunity of the mice to an intracerebral infection. Mice which received diluted vaccine (1 : 10) or fewer doses possessed a lower degree of immunity than the others, although they all survived intraperitoneal or subcutaneous infection with fresh brain virus. Only half the mice which survived intraperitoneal infection without previous vaccination proved immune to intracerebral infection, whereas 84 per cent of previously immunized mice were found to be immune. Intraperitoneal injection of a single dose of a rabies virus culture which had a very low virulence for mice conferred on the treated mice a high degree of immunity against a subsequent intracerebral infection with test-brain virus.

Absorption of Sulfanilamide

E. K. Marshall, jun., and W. C. Cutting (*Bull. Johns Hopkins Hosp.*, **63**, 328; 1938), of the Department of Pharmacology and Experimental Therapeutics, Johns Hopkins University, made the following studies of the absorption and excretion of sulfanilamide in the mouse and rat. Blood concentration curves were determined in these animals after administering sulfanilamide in different doses, in different vehicles and by different routes. The percentage excretion of the drug in eight hours by the kidney was determined, as well as the amount remaining unabsorbed in one hour in the intestinal tract. From the data obtained, it was concluded that the excretion was more rapid in the mouse than in the dog, rat or man. No significant difference was found when sulfanilamide was administered by different routes or in different vehicles. When large doses were given the maximum concentration in the blood of the rat was much lower than in the mouse.

The Glasshouse Leaf-Hopper

MR. G. FOX WILSON has collected much information about the glasshouse leaf-hopper, *Erythroneura (Zygina) pallidifrons*, in a recent short paper (*J. Roy. Hort. Soc.*, **63**, Pt. 10, Oct. 1938). The pest appears to have assumed serious proportions, and causes widespread damage to the leaves of many glasshouse plants. *E. pallidifrons* has been known for many years, but was first erroneously named *Zygina parvula*. Taxonomy, life-history, methods of feeding, and host range, are discussed in the paper, and control measures have also been investigated. Eradication is difficult, but the use of nicotine-soap wash offers the greatest possibility of success. The use of derris, pyrethrum extract or eucalyptus oil, and also fumigation with nicotine vapour or hydrocyanic acid gas, are alike in their inadequate control of the pest. An infestation may often be checked by removing the lower leaves of plants which are attacked, crushing the larvæ under the upper leaves, and removing weeds, particularly chickweed, which harbour the insect.

Pathogenic Yeasts

THE non-sporing yeast *Mycotorula albicans* is frequently associated with other fungi in various diseases of human skin. Its distribution as a parasite is apparently widespread, and Messrs. P. Redaelli, T. Castelli and R. Ciferri have shown (*Mycopathologia*, **1**, Fasc. 3, Sept. 1938) that it can be isolated from various Italian home-made bread yeasts. It does, in fact, perform the alcoholic fermentation of a leavening agent. There would seem little danger to human beings from eating bread baked with such mixed yeast, but as a source of infection it cannot be overlooked. Another non-sporing yeast, *Blastodendron Krausi*, has also been isolated from the same kind of yeast. It also can accomplish alcoholic fermentation of glucose, lævulose and maltose; but as yet is not a proved parasite of human beings.

Agaricaceæ of Hokkaido, Japan

THE second part of a very detailed study, by Sanshi Imai, of the gilled fungi of Hokkaido, Japan, has recently appeared (*J. Fac. of Agriculture*, Hokkaido Imperial University, **43**, Pt. 2, pp. 179–378, Aug. 1938). The first part, which was noticed in these columns (NATURE, **141**, 1105; 1938) was published in March of this year. This second part completes the account of Agaricaceæ, and raises the number of new species to forty. 348 kinds have, in all, been described critically. 233 of these are already known in Europe and North America; 49 species have previously appeared in Europe only, and 23 in North America. 43 species are indigenous in eastern Asia, and 196 species are new to Japan. Many fungi in Hokkaido are intermediate between European and North American species, thus giving additional confirmation of an ecological connexion with both regions. Edible and poisonous species are enumerated, but the account is of international value for its critical nature and its proposals for further subdivisions in existing classifications.

Mould Fungi of the Soil

DR. MARIE E. CAMPBELL has made a detailed study of Mucorales in the soil (*Trans. Roy. Soc. Edin.*, **59**, Pt. 2, 411–436; 1937–1938). Twenty-three species of this group of mould fungi have been isolated from seven samples of soil, and some conclusions of general mycological interest have been reached. Twenty of the species were heterothallic, and the remaining three homothallic. A hybridization, though somewhat imperfect, has occurred between the negative form of *Absidia cylindrospora* and the positive form of *Rhizopus nigricans*, thus adding possible interthallic crosses as another taxonomic difficulty to those already overwhelming the mycologist. Positive forms of the Mucorales are, in general, distributed more widely in soil than the negative strains, and there are indications that moorland and peaty soils contain fewer species of these fungi than cultivated fields. Many other details of culture, of spore longevity, of structure, of the effect of soil reaction and other factors, are given in the paper, which is further elucidated by fifteen text-figures and three excellent plates.

Thorough Cultivation of Soil

IN most countries, and especially in Great Britain, farmers have a traditional belief in the necessity and virtue of thorough cultivation. Although it is self-evident that some cultivation is needed to secure a satisfactory tilth, it is not certain that additional and deeper workings of the soil are as valuable as has been generally thought. At the present day when cultivation is one of the heaviest expenses on the farm, the question clearly needs reconsideration, and Dr. B. A. Keen has recently given some interesting results of investigations on the subject (*J. Min. Agric.*, **45**, 645; 1938). Experiments carried out over a number of years on heavy land showed that deep ploughing or subsoiling was of little or no benefit to a sugar beet crop, while extra ploughings, though they produced some small increase in the yield of the potatoes and sugar beet, were also uneconomic operations. Similarly, intensive inter-row cultivation of root crops, hitherto regarded as desirable, proved a waste of labour on both heavy and light land. The practice of rolling and harrowing cereals, on the other hand, was supported by experimental evidence. Rotary cultivation received special attention, comparison being made between plots prepared by the plough, the grubber and the rototiller. Germination tended to be quicker on the loose seed bed from the rototiller, but subsequent growth and yield were

very similar on all three sets of plots. If time presses, therefore, the quicker and cheaper process of grubbing can safely be substituted for ploughing, but the practice should not be continued for several years in succession, as weeds are liable to increase rapidly. The conclusion that, beyond a certain minimum, cultivation has little influence on crop yield has also been reached from experiments carried out on different soils and under different climatic conditions, but still further work is needed to determine if the results are of general application, or are typical of certain types of soil and climate only.

Helium Ratios of the Quincy Granite

IT is well known that the helium ratios of acid rocks, especially if coarse-grained, are usually much smaller than those of fine-grained basic rocks of the same geological age. A systematic programme of research to discover the source of these anomalies is being carried out by N. B. Keevil, and a report of his results on the Quincy granite and its minerals has recently appeared (*Amer. J. Sci.*, 406–416, Dec. 1938). The 'ages' computed from determinations of the helium, uranium and thorium contents are: quartz, 86 ± 5; riebeckite and aegirine, 86 ± 5; and alkali felspar, 49 ± 3 million years. The weighted 'age' calculated from these data and the mineral composition is in agreement with the 'age' determined from the granite itself—62 million years. A similar low 'age' for a Pre-Cambrian labradorite from the Adirondacks (101 ± 10 million years) suggests that leakage from felspars may be prevalent. Judging from the high degree of alteration of the Quincy felspar, the loss of helium in this case is ascribed to excessive crystal imperfections. Though the concentrations of helium and radioactivity in the riebeckite and aegirine are five times as high as in the other minerals, a relatively high 'age' was obtained, indicating that there has been no tendency for helium to diffuse towards a uniform concentration during the history of the rock. Further experiments are in progress to show whether low helium 'ages' may be due to leakage from felspar, and whether the most reliable results on rocks are to be obtained from quartz and the ferromagnesian minerals.

Geochemical Data of Southern Africa

DR. A. L. HALL has made a very valuable compilation of chemical analyses of rocks, minerals, ores, coals, soils and natural waters from Southern Africa. Geologists and others will welcome its publication by the Geological Survey of South Africa (*Mem.* 32, p. 868; 1938), particularly as the 5,983 analyses have been drawn from a widely scattered literature. Part 1 deals with material occurring within the Union of South Africa and South West Africa, while Part 2 covers the Rhodesias, Kenya Colony, Tanganyika Territory, Uganda, Nyasaland, the Belgian Congo, Madagascar, Mozambique, etc. The rocks analysed have been roughly classified as acid, intermediate, alkali, basic and ultrabasic, sedimentary and metamorphic, and as differences of opinion on matters of classification may introduce difficulties in running down particular analyses, a detailed index is provided. It is very convenient to have in one volume all the analyses (up to the beginning of 1936) of such petrologically important provinces as those of the Bushveld, the kimberlite pipes, the Karroo dolerites and lavas, the rift valleys, and other alkali-complexes. In this and other geochemical fields the volume will be of service in indicating where further chemical investigation is desirable, in preventing overlapping of analytical effort, and as a guide to the sources of information.

Tri-alkyl Derivatives of Lead

F. Hein and A. Klein have recently described a greatly improved method of preparing lead tri-ethyl and lead tri-methyl (*Ber. deutsch. chem. Gesells.*, Nov. 1938). The electrolytic method described by Midgley, Hochwalt and Calingaert in 1923 gives very low yields. This is due to the solvent action of alcohol on the product, which becomes transferred to the oxidizing action at the anode. By substituting $2N$ caustic alkali for alcohol a greatly improved yield results as the lead tri-ethyl is insoluble in water. Moreover an alkaline solution of lead tri-ethyl chloride can be used as electrolyte instead of previously isolating the hydroxide. The product separates in an almost pure condition at the lead cathode, but when pure water was substituted for alkali only lead and hydrocarbons were formed at the cathode. The appearance of troublesome by-products at the anode and the very slow formation of oily drops near the cathode before the application of the current led ultimately to the discovery that the tri-ethyl lead can be obtained easily, rapidly and almost quantitatively by a purely chemical method, namely, by reducing the alkaline solution of lead tri-ethyl chloride by metallic aluminium, lead or zinc at the temperature of the water-bath. After drying the oil with sodium sulphate it was analytically pure. When tin was substituted for aluminium, lead or zinc, an unstable substance, presumably lead di-ethyl from its scarlet colour, was formed but not isolated. No data are given as to the molecular complexity of the compound which was found by Midgley, Hochwalt and Calingaert to associate to the dimeric form in benzene except in dilute solutions.

Photochemical Theory of Vision

No. 583 of Messrs. Hermann's Series of Actualités Scientifiques et Industrielles (Paris) is the fourth of the biophysical series, and is entitled "La Base chimique et structurale de la Vision". It is written by Selig Hecht, professor of biophysics in Columbia University. It brings together a large amount of quantitative work which has been done on human and other eyes during the last ten years and shows that it is consistent with a simple photochemical theory of vision. According to this theory, there is initially in each cell of the retina a quantity a of a substance sensitive to light, and if light of intensity I has acted on it for t seconds and has converted x of the substance into photoproducts, which may combine with themselves or with other products to re-form the original sensitive material, the rate at which x increases with time under the action of light I is equal to $k_1 I(a-x)^m - k_2 x^n$ where k_1 and k_2 are constants, and m and n are 1 or 2 according to whether the reactions are mono- or bi-molecular. Curves are given showing how the least increment of intensity of light detectable under various conditions depends on I for each of the possible values of m and n and for both rods and cones of the retina, and the author shows how recent observations enable the values of m and n to be determined.

Scattering of Wireless Waves in the Ionosphere

By T. L. Eckersley, F.R.S.

THE purpose of this note is to direct attention to the real nature of the scattering of wireless waves in the ionosphere.* Particulars have been given in several papers (see references), but their significance does not seem to have been generally realized.

The essential facts are as follows:

(1) The echo pattern received on a linear time base near a high-power pulse transmitter on a frequency above the critical frequency is practically without exception of the type given in Fig. 1, in which the ground pulse G is followed by echoes at P which occur momentarily at apparent equivalent heights of 80–300 km., and a more distant irregular scatter group S. This group, while continually changing in detail, forms a permanent system of

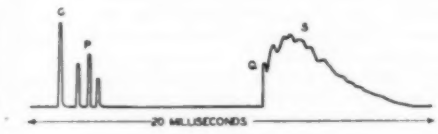


Fig. 1.

echoes, having a well-defined leading edge Q with an equivalent height between approximately 600 km. and 2,500 km. and extending until it is finally lost in the background noise. It is this group which forms the

*We are not here concerned with the 'broadening' of P echoes often observed at night.

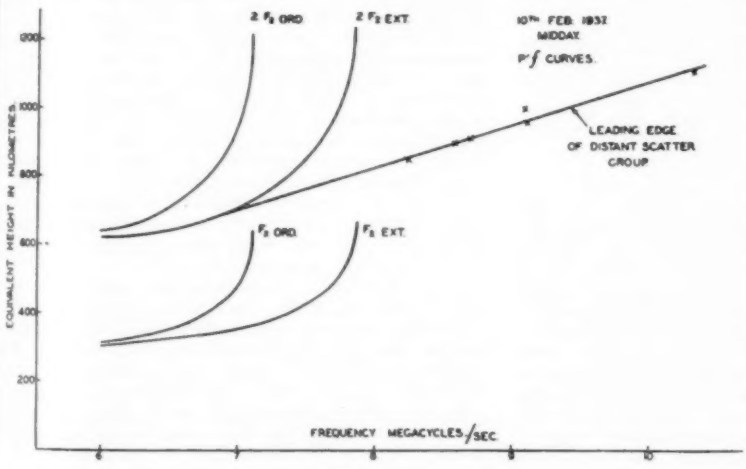


Fig. 2.

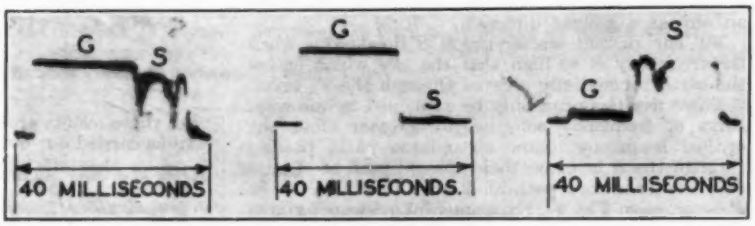


Fig. 3.

(a) GROUND SIGNAL, G; SCATTER, S. (b) GROUND SIGNAL MAXIMUM; SCATTER SUPPRESSED (c) GROUND SIGNAL SUPPRESSED; SCATTER MAXIMUM.

echoes of apparently great equivalent height which have been recorded by other workers.

(2) Spaced-frame experiments, which determine the direction of arrival of the echoes, show that the echoes in the scatter group S are never reflected vertically when the frequency is above the critical frequency, so that the delays of these echoes on the ground pulse do not represent equivalent vertical heights.

(3) The apparent equivalent height of the leading edge Q is a function of the frequency, and a typical curve is shown in Fig. 2. As the frequency is reduced, so that it approaches the critical frequency at vertical incidence, this equivalent height approaches that of the second order F_2 reflection, and the direction approaches the vertical. Thus the maximum equivalent height at which the scatter echoes are received vertically is associated with the second order F_2 reflection.

(4) If a beam transmitter is used, energy is scattered back from the direction in which the beam is pointing. This effect was explained by Mr. Tremellen in 1927, and we have verified it by numerous experiments since. Instead of using special high-power pulse transmissions to observe the scatter, as in Fig. 1, use can be made of commercial morse transmitters by choosing times when they are sending regularly spaced dots. Fig. 3 shows a set of photographs of such a morse dot observed on a linear time base when the speed was 25 cycles per sec. The transmitter was situated at Ongar, Essex, and had a beam directed on Salisbury, in South Africa. The frequency was 19·5 Mc./sec., and so was well above the critical frequency. The receiver was an Adcock direction finder situated only a few kilometres to the east at Chelmsford, and a strong ground signal was received from a direction nearly at right angles to the

direction of the beam. In (*a*) the scattered signal can be seen overlapping the ground signal and extending beyond it. This scatter was found to be strongest when the ground signal was suppressed as in (*c*), and was itself suppressed nearly at right angles to this direction, as in (*b*), at the maximum of the ground signal, when the goniometer indicated an almost southerly direction.

(5) The distant scatter group *S* disappears when the frequency is so high that the ray which leaves the earth tangentially escapes through the F_2 layer.

These five facts can only be explained in one way. Rays of frequency considerably greater than the critical frequency follow an oblique path, passing through the *E* layer on their upward path at *A*, and on their downward path at *B* after reflection at the *F* layer, as in Fig. 4. Experimental evidence[5] shows that the *E* layer is always full of irregular scattering clouds. Signals received at or near the transmitter are those which have been scattered back along their original outward path at *A*, giving rise to echoes of the type *P*, and at *B*, producing the distant scatter group *S* shown in Fig. 1. The results given in (5) above prove that there are no scattering clouds in the *F* layer similar to those in the *E* layer.

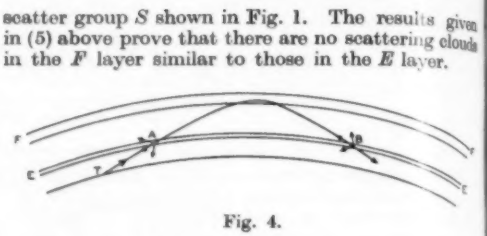


Fig. 4.

All these results are based on very numerous observations carried out over a number of years.

[1] *J. Inst. Elect. Eng.*, "An Investigation of Short Waves", 67, 995-97, (1929).

[2] *J. Inst. Elect. Eng.*, "Studies in Radio Transmission", 71, 439-42 (1932).

[3] *Marconi Review*, "Scattering, Polarisation Errors and Accuracy of S.W. Direction Finding", No. 53 (March–April, 1935) and No. 55 (July–August, 1935).

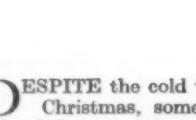
[4] "Gesammelte Vortrage der Hauptversammlung 1937 der Lilienthal-Gesellschaft für Luftfahrtforschung", pp. 322-329

[5] NATURE, 140, 846 (1937).

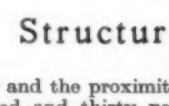
Structure of Proteins

DESPITE the cold weather and the proximity of Christmas, some hundred and thirty people attended a meeting of the Physical Society on December 20 at which Dr. Irving Langmuir delivered an address on the structure of proteins. He began by enumerating the facts which pure chemistry had succeeded in accumulating about these substances, which play such an important part in living Nature. By the union of two amino acids, with the elimination of a molecule of water, the polypeptide unit is built up. Chemically, this has two valence bonds free, one at each end, and thus seems adapted solely for the formation of chain compounds. If proteins are indeed chain compounds, it would be difficult to understand why they have apparently definite molecular weights (often multiples of 18,000), or why the molecule behaves approximately as a spherical one.

A few years ago, Dr. Dorothy Wrinch suggested that, instead of the polypeptide unit (I),



I



II

where *R* is one of a number of radicals, the unit might really be (II), which differs from it only in the position of a proton within the molecule. It has, however, four free valency bonds, which (being attached to nitrogen or carbon atoms) make angles of 109° with each other. Investigation of the spatial arrangements possible with such a unit shows that they can form closed 'cages', the plane sides of which are constructed of a lacework of hexagons. The discrete molecular weights (and indeed the ratios of these) thus receive a natural explanation, as does the approximately spherical shape of the molecule.

One cage in particular contains 288 amino-acid residues, which is equal to the number determined by physico-chemical methods in the case of egg albumin, within the limits of accuracy of these methods. In this particular case, the cage is a truncated tetrahedron which does not differ greatly from an octahedron.

Now proteins can be 'denatured' by various mild treatments (shaking for three or four minutes, or heating to 65° C. for one or two minutes are sufficient in some cases) and then show markedly different properties from native proteins, but no change in molecular weight. It is suggested that these denatured proteins are in fact composed of the polypeptides which the chemist had discovered, since the treatment which he necessarily applies in order to make investigations would be sufficient to cause the change. The ease of denaturation, and the great alteration in properties, both follow naturally from this hypothesis, taken in conjunction with the 'cyclol' hypothesis adopted for native proteins.

A particularly interesting fact which receives explanation by these theories is the insolubility in water of mono-molecular layers of proteins formed from soluble native proteins. The explanation lies in the positions of the side chains *R*, which in the cage structure are arranged around the edges of the hexagonal lacunæ composing the plane sides of the cage, whereas in a mono-molecular layer, the cage is developed into a plane. When *R* is hydrophobe, the mono-molecular layer is formed with these radicals projecting; in the 'cage' they project into the interior and are thus marked.

The last part of the lecture was devoted to the X-ray evidence, which is most complete in the case of insulin, since as shown by Crowfoot, this particular protein has but one molecule per unit cell, and the results are therefore more easily interpreted than would be the case with most proteins.

Dr. Langmuir stressed the point that the X-ray data, like many of the other facts explained by the theory, such as the appearance of α- but no β-amino acids, were not used as data in constructing it originally; nevertheless, the results of the X-ray

investigation, in Dr. Langmuir's view, confirm many features of the structure to which the theory had led.

In the discussion which followed the address, Dr. Wrinch explained that the method used by Langmuir and Wrinch in interpreting the vector maps was a geometrical formulation of the classical picture of a crystal as a set of discrete units. Prof. J. D. Bernal uttered a word of caution against supposing that the theory was proved. He thought that certain features must be true, and others were possibly true, but in his view the X-ray data fail to confirm the proposed structure. He had had a vector map calculated for the latter, and found that it differed very markedly from that obtained experimentally. Prof. E. H. Neville showed the care that is needed in interpreting a vector map, by a simple example in which a map constructed from a given set of points appeared at first sight to correspond to quite a different type of distribution.

Studies in Galactic Structure

IN *Bulletin of the Astronomical Institutes of the Netherlands*, No. 308, J. H. Oort investigates the structure of the galactic system from counts of faint stars in medium and high galactic latitudes combined with absorption data from Hubble's counts of extra-galactic nebulæ. Data for the star density were derived from Kapteyn's Selected Areas; the amount of absorption to be used for each selected area was estimated from nebular counts in neighbouring fields.

Assuming tentatively that the absorption occurs in front of the stars studied, the investigation leads to a picture of the galactic system differing somewhat from the prevalent conception: broadly, the sun appears to be situated in a region of relatively low star density surrounded in all galactic longitudes by extensive regions where the density is at least twice as high. The structural features indicated are large-scale phenomena, extending on both sides of the galactic plane to distances of 500 or 700 parsecs (say 1600–2300 light years) from this plane. The analogy between this structure and the spiral structure of strongly flattened extra-galactic systems is discussed; but the data are insufficient to define the course of the spiral arms, although the sun apparently lies between two arms. At greater distances from the galactic plane, the unevenness in density distribution disappears; at levels between 800 and 1800 parsecs the equidensity surfaces are satisfactorily represented by planes inclined at angles of about 10° to the galactic plane, implying an increase of density in the direction of the galactic centre by a factor 1·38 per 1000 parsecs. The derived longitude of the centre is 324° ± 3° (region of Scorpio–Sagittarius), in excellent agreement with the longitude derived from the effects of differential rotation or from the distribution of globular clusters and planetary nebulæ. As regards selective absorption, the evidence from colour-excess data in the Kapteyn Areas points to a strong galactic concentration of the absorbing clouds, and indicates that the greater part of the absorption derived from Hubble's counts of nebulæ must have occurred relatively close to the galactic plane.

From the time of Sir William Herschel, the dark patches and lanes, more or less devoid of stars, in the Milky Way have been an attractive problem for astronomers. It is now known that these dark areas must be due chiefly to clouds of cosmic dust. In Publication No. 48 of the Kapteyn Astronomical Laboratory at Groningen, an estimate is made by B. Hiemstra of the distances of some absorption clouds in areas 2, 5, 9 and 24 of Kapteyn's Selected Areas.

From a statistical study of proper motions and apparent magnitudes of the stars in the absorbing regions and in the surrounding rich areas, the author is able to derive limits for the distance and absorption effect of the clouds, assuming them to be of infinitesimal thickness compared with their distance. The results range as follows: Area 5 contains a cloud absorbing $0{\cdot}8^m$–$1{\cdot}5^m$ at a distance less than 300–400 parsecs. Area 2 contains a cloud absorbing at least $0{\cdot}5^m$ at a distance of 600–1200 parsecs. In area 9, lying east of the North America Nebula, the absorption reaches $2{\cdot}0^m$ at a distance of 500–650 parsecs. The plates used in the investigation were taken at the Radcliffe Observatory, Oxford, with the 24-inch refractor, which was recently presented to the University of London Observatory at Mill Hill. Usually the pairs of plates were taken about fifteen years apart.

Education for Citizenship

PREPARATION for and training in citizenship are recognized by an increasing number of people in Great Britain as of vital national importance and as calling urgently for the development and extended application of effective techniques. There is much to interest them in "Forums for Young People", a pamphlet recently issued by the United States Office of Education (Washington, D.C., Superintendent of Documents. 15 cents). This is a study of problems and plans involved in providing organized series of free discussions of public affairs for high school and college students and for other young people. For two years, the Commissioner of Education has conducted, with the help of very substantial Federal grants, a vigorous propaganda for the organization of public affairs forums throughout the States, and the resulting experiments have provided ample material for this study, the publication of which will, he hopes, "contribute to the thinking of the teaching profession and of laymen on this problem of finding ways and means to make secondary and higher education meet its civic responsibilities". It begins with an admirably lucid discussion of pros and cons. The point of view taken is that the most important purpose of education in our time is the training of the mind to deal intelligently with *the undecided issues which face mankind*. Subsequent chapters describe: types of forum

programmes for high schools, forum plans for colleges and universities, forum plans for youth on community-wide basis and "guide-posts to organisation".

Some of the problems of "Forums for Young People" were discussed at the Secondary School Conference held by the Association for Education in Citizenship last year at Morley College, London. A report of the proceedings at this conference appeared in the July number of the *Citizen*. The conference covered a wider field, including consideration of the part played by character and purpose in the making of good citizens, and the efficacy of various out-of-school activities such as scouting, classes in first-aid, and camping as means for stimulating emotion and imagination and harnessing them to action in the service of the community so as to overcome "that apathy which is the besetting weakness of democracy". With the view of keeping in touch with one another the now considerable number of schools where systematic efforts are made to foster the development of a spirit of community service a "Schools Community Service Group" has been constituted within the Association with headquarters at The Downs School, Colwall, Malvern, with Mr. W. F. Hoyland as honorary secretary. The chief subjects dealt with by the group are: manual work on the school estate, help at physical training and play centres, boys' clubs and school missions, visits to factories, housing estates, etc., work camps in the holidays, for example, helping unemployed men on their allotments, school expeditions abroad.

In the same number of the *Citizen* is an article of outstanding interest by Prof. René Maheu of the Institut Français du Royaume-Uni on the teaching of philosophy in French secondary schools. The philosophy teachers are, it appears, allowed the greatest freedom both as to method and as to subject, and most of them concentrate on instruction "not so much in facts or ideas as in the sovereign art of passing judgment". They seek to equip their pupils with the techniques of self-knowledge and of objective thinking. To them is available the sole opportunity given to secondary school teachers of "effectively helping their pupils to decide for themselves with their own reasoning powers, the use they are to make of their freedom as citizens".

The Differential Analyser in Electrical Engineering

IN recent years, there has been a considerable development in the design and use of mechanical and electrical instruments for carrying out calculations of various kinds. These calculations can be divided into two main groups: first, there are those which consist of the four processes of arithmetic (addition, subtraction, multiplication and division) combined in any way, and secondly there are those which involve the further ideas of the calculus. For the latter group of calculations, the solution of differential equations is one of special importance both in pure and in applied science, as in both fields there arise many kinds of differential equations which have no formal solution or none convenient for numerical evaluation, but for which quantitative information about the behaviour of the solution is required.

In a paper by Prof. D. R. Hartree and Mr. J. K. Nuttall on the differential analyser and its applications in electrical engineering (*J. Inst. Elec. Engineers*, No. 503), a description is given of the differential analyser, and it is shown that the solutions of non-linear differential equations can be readily obtained by its use. Although it is possible to evaluate the solutions of such equations numerically and sometimes graphical methods can be employed, yet except for simple equations, numerical methods are laborious and lengthy, and graphical methods are limited in scope and accuracy and are also laborious to carry out on a large scale. The general idea of such a machine was due to Lord Kelvin. The practical realization of the idea is due to Dr. V. Bush, of the Massachusetts Institute of Technology, where the first machine of this kind was designed and constructed. A similar machine built by the Metropolitan-Vickers Electrical Co., Ltd., is installed at the University of Manchester and there is another at the University of Pennsylvania.

Immediately following the paper describing the differential analyser, there is an excellent account of the practical application of it to study the transients on a distortionless transmission line, by Prof. Hartree and Dr. Porter. The ever-increasing volume of technical literature on lightning and its effects on transmission lines and terminal equipment provides evidence of the attention now being paid by engineers to this problem. It is now known that the severity of a transient occurring at a line terminal may be lessened by flattening the front of the wave, by means of wave modifiers or surge absorbers or by reducing its amplitude by means of 'arresters' of various types. The principal features of the majority of arresters of the 'spillover' type is that their action depends on the use of a material having a non-linear current-voltage characteristic.

This paper describes the solution of the problem of evaluating the history of a transient on a finite line with such a non-linear impedance at one or both ends. The behaviour of a transient on a finite distortionless line can be described in terms of two travelling-wave systems propagated in opposite directions along the line. The voltages in these two waves satisfy two ordinary differential equations depending on the terminal conditions, and involving a relation between the voltage at two times differing by the time of travel of a wave from one end of the line to the other and back. Equations of this type can be handled mechanically by means of the differential analyser, and the use of the differential analyser does not require that the terminal impedances should have linear characteristics. The authors apply the instrument to a line with a capacitance at one end and a non-linear resistance (lightning arrester) at the other. Specimens of machine solutions, both with a linear and a non-linear resistance at the far end, are given and discussed, and compared with oscillograms taken on an actual line.

Electric Power Supply in India

AT the annual meeting of the National Academy of Sciences, India, held on March 5, a symposium was arranged on the subject of India's power supply. In opening the discussion, Prof. M. N. Saha said that no subject could at the present moment be of greater importance than that of a cheap and abundant power supply. The whole industrial efficiency of a nation depends on it. He pointed out that there are countries in the world that have developed all their power resources—Norway, United States, England and Germany; but India, China and Abyssinia are still dependent on a medieval economy. In Norway, the total output per head per annum is nearly 1,800 units. In England and Germany the power is mainly derived from coal, but the output per head is probably nearly the same. In India the output cannot exceed 90 units, of which about 60 is from human labour, 10 from animal power and 20 from steam and electrical power combined.

If the problems of poverty and unemployment in India are to be solved, the power resources of the country must be organized so as to bring them to the level of Europe, America and Japan. Dr. Tandon said that the sponsors of the Ganges canal project would have done better service to the country if, instead of trying to capture the public imagination by the ideal of rural electrification, they had concentrated the load near the generating stations for the development of the heavy chemical industries.

Pandit J. Nehru, in summing up the discussion, said that everyone saw the necessity of establishing a power research and survey institute. But democratic Governments are greatly burdened by their ordinary routine work, and complaints from innumerable persons who now have access to them. The first things they do are naturally those demanded by hundreds of thousands of people, and so they have no time to listen to the counsels of a few dozen, however great their reputation may be. The expert man of science is not always a helpful person. He does not realize that things which have to be put before the Government must be definite and that the proposals must fit in with the realities of the situation. He asked the Academy to draw up definite proposals for benefiting the nation, and not vague aspirations as to what should or might be done.

At a subsequent meeting on March 29, Prof. Saha moved a series of resolutions which were unanimously carried. The Government is requested to appoint a committee of legal and scientific experts, and representatives of industry, to study the present Electricity Act and to recommend the necessary legislation required to nationalize the generation and distribution of electricity with the view of making the supply of electrical power in the country cheap and abundant. The second resolution requests the Government to select a body of graduates in physics and electrical and chemical engineering, and to send them to study the methods adopted in countries such as England, the U.S.S.R. and Switzerland. The third resolution is a request that a permanent body called the "Power Survey and Research Institute" be appointed. Finally, the National Academy noted with regret that the Government of the United Provinces, when appointing an Electricity Committee, did not consider it necessary to ask the Academy to nominate a specialist to serve on the Committee.

Science News a Century Ago

Invention of Daguerrotype

ON January 7, 1839, Arago described to the Paris Academy of Sciences the invention of Louis Jacques Mande Daguerre (1789–1851) for the photographic process of taking pictures on metal plates. Writing from Paris, a correspondent of the *Athenæum* said, "So universal an interest was excited here by the paper read by M. Arago, that I called on M. Daguerre to possess myself, as far as was permissible, of the facts of this very extraordinary discovery. . . . Of course, I can as yet give no precise details as M. Daguerre naturally objects to impart them to anyone, till he has received definite answer from the Government, with whom he is in treaty for the sale of his secret. I should add that the discovery is authenticated past the power of question by the testimonials of such men as Biot, von Humboldt and M. Arago. His earlier sketches of four years ago have a slight haziness; some of his last works have the force of Rembrandt's etchings." Of the various subjects of Daguerre pictures, the correspondent mentioned the Quays of Paris, the Louvre and Notre Dame, the picture of the last having been taken in the rain.

Daguerre had begun life as an inland revenue officer, then became a stage painter, and in 1822, in conjunction with M. Bouton, opened the Diorama in Paris, which for seventeen years was a great attraction. For many years he endeavoured to produce permanent pictures by the action of sunlight, and collaborated with Nicéphore Niepce (1765–1833). Daguerre's pictures were produced on plates of silver covered with a film of iodide. After exposure, the plates were developed by means of mercury vapour and fixed in a bath of hyposulphite of soda.

Parallax of α Centauri

ON January 9, 1839, the discovery of the parallax of α Centauri was communicated to the Royal Astronomical Society by Thomas Henderson (1798–1844), the first Astronomer Royal for Scotland, to which office he had been appointed in 1834, a year after his return from the Cape of Good Hope. "With a view," said Miss Clerke, "to correcting the declination of the lustrous double star α Centauri . . . he effected a number of successive determinations of its position, and on being informed of its very considerable proper motion (3·6″) annually he resolved to examine the observations already made for possible traces of parallactic displacement. This was done on his return to Scotland. . . . From the declination measurements made at the Cape and duly reduced, a parallax of about one second of arc clearly emerged . . . but, by perhaps an excess of caution, was withheld from publication until fuller certainty was afforded by the concurrent testimony of Lieutenant Meadows' determinations of the same star's right ascension. When at last, January 9, 1839, Henderson communicated his discovery to the Astronomical Society, he could no longer claim the priority which was his due. Bessel had anticipated him with the parallax of 61 Cygni by just two months."

William MacMichael (1784-1839)

DR. WILLIAM MACMICHAEL, an eminent London physician, who died on January 10, 1839, was born at Bridgnorth in Shropshire in 1784, the son of a

banker. He was educated at the local grammar school and Christ Church, Oxford, where he qualified in 1808. Appointed Radcliffe travelling fellow in 1811, he visited Russia, Turkey, the Balkan States and Palestine, and in 1817 and 1818 recorded his experiences of the journey. In 1818 he settled in London and four years later was appointed physician to the Middlesex Hospital. In 1829 he was made physician extraordinary to the King. At the Royal College of Physicians, of which he was elected fellow in 1818, he held the office of censor in 1822 and 1832 and of registrar in 1824. MacMichael is best known as the author of "The Gold Headed Cane" which was published anonymously in 1827 and contained the lives of Radcliffe, Mead, Askew, Pitcairn and Baillie, the successive owners of the cane, now in possession of the Royal College of Physicians. He was also the author of "Lives of British Physicians" (1830), also published anonymously and written in the same delightful style as the previous work, as well as of unimportant books on scarlet fever (1822) and cholera (1831).

Magnetical Observations

IN its report of the meeting of the Royal Society held on January 10, 1839, the *Athenæum* included the report to the Council by the Joint Committee of Physics and Meteorology appointed to consider the propriety of recommending the establishment of fixed magnetic observatories and the equipment of a naval expedition for observations in the Antarctic. The report, signed by Sir John Herschel, was approved, and Herschel, together with Sabine and Wheatstone, were requested to wait on Lord Melbourne. After reading the report, Lord Melbourne stated that he would urge Her Majesty's Government to adopt measures for carrying the resolution of the Council into immediate effect.

University Events

CAMBRIDGE.—The International Wool Publicity and Research Secretariat is supporting in the University a research studentship at the School of Biochemistry, and on the conclusion of the present holder's tenure it will consider providing for a further tenure appointment to which will be made by the University. The present holder is R. L. M. Synge, of Trinity College.

L. C. Young, of Trinity College, has been approved for the degree of Sc.D.

Dr. W. Feldberg has been appointed University lecturer in physiology.

The subject proposed for the Adams Prize for the period 1939–40 is "The Theory of Numbers". This phrase may be interpreted in the widest sense and as including, for example, the additive, algebraic, analytic and geometric theories.

READING.—Prof. F. J. Cole, professor of zoology since 1906, is resigning from the chair in September. Prof. Cole's researches have dealt chiefly with comparative anatomy and the history of zoology. From 1895 until 1906 he was lecturer in zoology in the University of Liverpool.

Societies and Academies

London

Royal Society (*Proc.*, A, **169**, 1–148; 1938).

SIR WILLIAM BRAGG: Presidential address.

J. L. LIZIUS and A. J. ALLMAND: The simultaneous sorption of carbon bisulphide and water vapour by activated charcoals.

R. F. BARROW and W. JEVONS: The band spectrum of silicon monosulphide and its relation to the band spectra of similar molecules.

R. W. SILLARS: The behaviour of polar molecules in solid paraffin wax.

J. SAYERS: Ionic recombination in air.

P. WEISS: (1) On the Hamilton-Jacobi theory and quantization of a dynamical continuum. (2) On the Hamilton-Jacobi theory and quantization of generalized electrodynamics.

E. A. GUGGENHEIM: The statistical mechanics of co-operative assemblies.

Edinburgh

Royal Society of Edinburgh, December 5.

A. R. GLEN: The Oxford University Arctic Expedition to North East Land, 1935–1936. The north coast of the island was mapped in detail, while reconnaissance surveys were made of the east and south coasts. The ionosphere research carried on at the base in Brandy Bay yielded results of considerable value to the further development of world wireless communications, while measurements of the atmospheric ozone and observations on the auroræ were successfully made. The geology and biology of North East Land were studied in some detail. Finally, at two stations established on the inland ice a comprehensive programme of glaciological and meteorological research was completed.

VERA FRETTER: Structure and function of the alimentary canal of some tectibranch molluscs, with a note on excretion. The morphology, minute structure and functioning of the gut of four species of tectibranch molluscs has been described. Food, sensed by cephalic sense organs and raked in by the radula, is crushed by calcareous plates in the gizzard and exposed to enzymes from the salivary and digestive glands. Digestion of carbohydrates, proteins and fats occurs, soluble products and minute particles being passed through the stomach to the liver for absorption and further digestion. Indigestible food from the digestive gland is excreted via the anus and the kidney in different proportions in bivalves and gastropods.

MRS. E. M. BEATTIE: Investigation of visual threshold values. The main object of the work was the determination of the effect of fatigue, under certain conditions, on the magnitude of the threshold value. The time of fatigue by a light of given intensity was varied, and it was found that the apparent intensity, as measured by the critical frequency of flicker, of another light, also of constant intensity, was markedly increased by increase of the time of fatigue. The same condition holds when an interval of time elapses between the cessation of fatigue and observation of the second light, but the effect is smaller.

Paris

Academy of Sciences (*C.R.*, **207**, 1137–1268, Dec. 12, 1938).

G. BERTRAND : Quantity of zinc in sea water. Samples of water off the coasts of France and of the Dead Sea have been examined by a chemical method (determination as calcium zincate); the figures obtained are 3–4 mgm. and 4·37 mgm. zinc per litre respectively.

L. BLARINGHEM and K. C. CHIN : New cases of xenia in wheat hybrids (*Triticum monodurum*, *T. ægilopoides* and *T. vulgare*).

E. ROUBAUD, J. COLAS-BELCOUR and G.-J. STEFANOPOULO : Behaviour of yellow fever virus in the mosquito *Aedes geniculatus*. Transmission of the fever occurs when the mosquitoes are kept at 30-35° C., but not when they are at 20–22° C.

V. VOLTERRA and V. A. KOSTITZIN : Remarks on the toxic action of the medium, *à propos* a note by M. Regnier and Mlle. Lambin [Development of *Staphylococcus aureus* and *Bacillius coli* in a liquid medium].

P. LEJAY : Gravimetric map of the Philippines.

P. LÉVY : Brownian movement and geometric schemes.

C. PAUC : Contribution to the problem of M. Fréchet relating to the investigation of a derivable parametrization for curves with a tangent at every point.

M. BRELOT : Closed ensembles.

A. DVORETZKY : Semi-convergence of series, and in particular of Dirichlet series.

M. GODEFROY and H. PONCIN : The idea of stability.

A. FOCH and C. CHARTIER : Chromo-photography and gyratory flow.

V. VOLKOVISKY : Some properties of vertical trajectories in plane problems of convection.

L. MALAVARD : Correction of air-flow for an elliptic channel.

J. SOLOMON : Quantum theory of gravitation.

J. GÉHÉNIAU : Wave mechanics of the heavy electron.

N. CABRERA : Perturbation of a problem of proper values by deformation of the boundary.

J. ROUBAUD-VALETTE : Certain equations representing a photon.

MME. M.-A. TONNELAT : Relations between the theory of the photon and the theory of the heavy electron.

A. PROCA : A symbolic equation combining the equations of the mesotron (heavy electron), those of Kemmer, of Klein-Gordon and the L. de Broglie equations of the photon.

C. SALCEANU : Experimental arrangements for measuring the velocity of sound in liquids by a resonance method : measurement of the velocity of sound in mercury. The mean velocity at 22·5° C. found was 1,407 m./sec.

L. TISZA : Viscosity of liquid helium and the Bose-Einstein statistics.

T. BOGGIO : Movement of an electrified particle in an electric field and in a superposed magnetic field.

Y. ROCARD : Weakening of the electromagnetic fields on ultra-short waves at river crossings. Such local effects may give useful information to aircraft.

M. LEMARCHANDS and W. JUDA : Discussion of the phenomena of electrolytic *surtension*.

(*To be continued.*)

Rome

National Academy of the Lincei (*Atti*, **27**, 471–492 ; 1938).

G. GHERARDELLI : Construction of equivalence series on a reducible algebraic curve.

C. CATTANEO : Contact of two elastic bodies : local distribution of the forces (3).

A. ALIBRANDI : New experimental confirmation of the necessary participation of the inborn afferent path in the mechanism of conditioned reflexes.

G. ARAGONA : New observations on the blood-sugar raising pancreatic hormone of G. Martino.

V. CAPRARO : *p*H value of the content of the seminal vescicles of the albino rat.

V. ZAGAMI : Experimental researches on the seminal fluid. (3) Variation of the *p*H of the human fluid with temperature and dilution.

Atti, **27**, 493–603 ; 1938.

F. ENRIQUES : Characteristic properties of irregular algebraic surfaces.

U. BARBIERI : Geodetic-astronomical station erected on the trigonometric vertex of Montecastello near Alessandria in August 1934.

G. QUAGLIARIELLO and F. CEDRANGOLO : Solubility of fatty acids and of glycerides in bile and in bile salts.

A. STELLA : New studies on the tin deposit of Campiglia.

J. C. VIGNAUX : Polygenic functions of one and of several dual complex variables and of bidual variables (1).

E. FROLA : Cauchy's problem and equations with linear partial derivatives having constant coefficients.

G. N. WATSON : Tabulation of a particular function defined by an improper integral.

T. BOGGIO : Solutions of a system of equations with partial derivatives.

O. CHISINI : A more general theory of the existence of multiple planes.

G. C. MOISIL : Geometrical considerations of the integration method of Hadamard-Théodoresco (1).

A. CABRAS : Resolution of a problem relating to the perturbations imposed on continuous systems.

G. LAMPARIELLO : Stationary motions in the dynamic problems of Liouville.

O. ZANABONI : Possibility of neglecting the work due to the deformation of the cutting surface and of the axial force in comparison with that of the moments.

G. L. ANDRISSI : Solar radiation at Rome from 1933 until 1936.

G. WATAGHIN : A system of gravitational equations of the first order (2).

G. GIACOMELLO : Structure of some triterpenes.

C. PERRIER and E. SEGRÈ : Some chemical properties of element 43 (2).

R. PIONTELLI : Influence of ultra-sonics on discharge potentials of hydrogen, oxygen and chlorine.

A. CAVINATO : The Permian in the Orroli territory (Sardinia).

S. DOJMI DI DELUPIS : Phenomena of activation in plant growth (1).

G. GOIDÀNICH : New observations on the drying of shoots of poplars.

A. ALIBRANDI : Efficacy of the spoken word in producing the conditioned reflex of blinking in dogs.

V. ZAGAMI : Experimental researches on the seminal fluid (4). *p*H value of dog's seminal fluid.

Forthcoming Events

Tuesday, January 10

PHARMACEUTICAL SOCIETY, at 8.30.—Prof. J. H. Gaddum: "Recent Discoveries about Animal Hormones".

Friday, January 13

PHYSICAL SOCIETY, at 5.15.—Sir Ambrose Fleming, F.R.S.: "Physics and Physicists of the Eighteen-seventies".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT LECTURER IN ELECTRICAL ENGINEERING in University College, London—The Secretary (January 14).

UNIVERSITY READER IN METEOROLOGY in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (January 20).

UNIVERSITY READER IN BIOCHEMISTRY in Guy's Hospital Medical School—The Academic Registrar, University of London, Senate House, W.C.1 (February 1).

CHEMIST in the Institute for Medical Research, Federated Malay States—The Director of Recruitment (Colonial Service), 8 Buckingham Gate, London, S.W.1 (February 10)

ASSISTANT PROFESSOR OF PHYSICAL AND GENERAL CHEMISTRY and ASSISTANT PROFESSOR OF MINERAL AND INORGANIC CHEMISTRY in the Indian Institute of Science, Bangalore, India—The Registrar (February 15).

ASSISTANT ADVISORY OFFICER to the Board of Greenkeeping Research—The Director, St. Ives Research Station, Bingley, Yorks.

DIRECTOR OF RESEARCH to the Research Association of British Flour-Millers—The Secretary at 40 Trinity Square, London, E.C.3.

BACTERIOLOGIST in the Research Laboratory of the Royal College of Physicians of Edinburgh—The Secretary, Royal College of Physicians, Edinburgh, 2.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Journal of the Electrodepositors' Technical Society. Vol. 14. 1937–38. Pp. viii+252. (London: Electrodepositors' Technical Society. Northampton Polytechnic Institute.) 15*s.*; to non-Members, 21*s.* [512

A Report on the Museum and Art Galleries of the British Isles (other than the National Museums). By S. F. Markham. Pp. iii+179+24 plates. (Dunfermline: Carnegie United Kingdom Trust.) [612

Museums and the Public. Pp. 14+2 plates. (Dunfermline: Carnegie United Kingdom Trust.) [612

West Cumberland (with Alston): a Survey of Industrial Facilities. By G. H. J. Daysh. Pp. 176+10 plates. (Whitehaven: Cumberland Development Council, Ltd.) [812

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 697: Some Facts concerning means of Transportation and Methods used in Marketing New York State Fruits and Vegetables. By M. P. Rasmussen. Pp. 113. Bulletin 701: Economic Studies of Vegetable Farming in New York. 4: Production and Marketing of Cauliflower in Delaware County, 1936. By J. N. Efferson. Pp. 45. Bulletin 702: Economic Studies of Vegetable Farming in New York. 5: Production and Marketing of Lettuce in Oswego County, 1936. By J. N. Efferson. Pp. 41. Bulletin 703: Soil and Field-Crop Management for Southwestern New York. By A. F. Gustafson. Pp. 47. Bulletin 704: Types of Farming in New York. By R. S. Beck. Pp. 71. Bulletin 705: Soils in relation to Fruit Growing in New York. Part 12: Tree Behavior on Important Soil Profiles in the Peru, Plattsburg and Crown Point Areas in Clinton and Essex Counties. By Joseph Oskamp. Pp. 27. (Ithaca, N.Y.: Cornell University.) [212

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 31: A Survey of Courses of Study and other Curriculum Materials published since 1934. By Bernice E. Leary. Pp. v+185. (Washington, D.C.: Government Printing Office.) 20 cents. [212

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par Sir D'Arcy Wentworth Thompson. Vol. 26, pour l'année 1936. Pp. xxviii+49. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr. [512

Annual Report of the Public Health Commissioner with the Government of India for 1936. Vol. 1, with Appendices. Pp. vi+353. (Delhi: Manager of Publications.) 2 rupees; 3*s.* 6*d.* [512

Union of South Africa: Department of Mines, Geological Survey. Memoir No. 32: Analyses of Rocks, Minerals, Ores, Coal, Soils and Waters from Southern Africa. Compiled by Dr. A. L. Hall. Pp. 876. (Pretoria: Government Printer.) 15*s.* [512

The Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation. Fifteenth Annual Report, 1938. Pp. 6. (Boston, Mass.: Dr. Joseph C. Aub, Secretary, Huntington Memorial Hospital.) [512

Journal of the Indian Institute of Science. Vol. 21A, Part 2: Hydrogenation of Oils by the Continuous Process. Part 5: Mechanism of Continuous Hydrogenation of Oils. By V. T. Athavale and S. K. K. Jatkar. Pp. 321–330. 14 annas. Vol. 21A, Part 28: Studies in Biological Systems. Part 1: Adsorption from Binary Mixtures of Toluene and Acetic Acid by Charcoal and Silica Gel. By J. G. Kame and S. K. K. Jatkar. Pp. 331–344. 1.2 rupees. Vol. 21A, Part 29: Metal—Metal Oxide Electrodes. Part 1: Studies in Tungsten and Molybdenum Electrodes. By C. T. Abichandani and S. K. K. Jatkar. Pp. 345–362. 1.4 rupees. Vol. 21A, Part 30: Differential Titrations with Tungsten Electrode. By C. T. Abichandani and S. K. K. Jatkar. Pp. 363–368. 10 annas. Vol. 21A, Part 31: Automatic Potentiometric Titration Apparatus. By C. T. Abichandani and S. K. K. Jatkar. Pp. 369–372. 8 annas. (Bangalore: Indian Institute of Science.) [512

Bulletins of Indian Industrial Research. No. 13: A Study of Indian Mustard and Rape Seeds and their Oils. By D. Y. Athavale, J. A. Hare Duke and P. N. Mathur. Pp. ix+20+8 plates. (Delhi: Manager of Publications.) 14 annas; 1*s.* 3*d.* [512

Southern Rhodesia, Geological Survey Bulletin, No. 33: The Geology of the Country around the Jumbo Mine, Mazoe District. By J. C. Ferguson and the late T. H. Wilson. Pp. iv+137+8 plates. (Salisbury: Government Stationery Office.) 4*s.* 6*d.* [612

National Research Council. Transactions of the American Geophysical Union, Nineteenth Annual Meeting, April 27 to 30, 1938, Washington, D.C.: Regional Meetings, December 28 to 29, 1937, Spokane, Washington, January 7–8, 1938, Davis, California, June 21, 1937, Denver, Colorado (Addendum). Part 1: Reports and Papers, Washington, D.C., General Assembly and Sections of Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, Volcanology and Hydrology. Pp. 585. Part 2: Reports and Papers, Section of Hydrology and Western Interstate Snow-Survey Conference. Pp. 587–745. (Washington, D.C.: National Academy of Sciences.) [812

Department of Agriculture, Fiji. Annual Bulletin of Divisional Reports, 1937. Pp. iv+96. (Suva: Government Printer.) 2*s.* 6*d.* [812

Intensity Relations in the Low Voltage Helium Arc. By John Jacob Heilemann. Pp. 10. On the *S*-States of the Two-Electron Atom. By Fred George Fender. Pp. 16. Growth and Decay of Phosphorescence in Calcium Sulphide by a Photo-electric Method. By Peter John Mulder. Pp. 24. (Philadelphia: University of Pennsylvania.) [812

Abridged Scientific Publications from the Kodak Research Laboratories. Vol. 19, 1937. Pp. 288+viii. (Rochester, N.Y.: Eastman Kodak Company.) [812

Advisory Committee on Education. The Federal Government and Education. Pp. 32. (Washington, D.C.: Government Printing Office.) 10 cents. [812

Brooklyn Botanic Garden Record. Vol. 27, No. 3: Botanic Gardens of the World; Materials for a History. Second edition. Pp. 151–460. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) 2.50 dollars. [812

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 23, No. 23: Studies on the Cladocera of Monterey Bay. By Harriet Marguerite Baker. Pp. 311–365 (plates 26–31). (San Francisco, Calif.: California Academy of Sciences.) [812

Transactions of San Diego Society of Natural History. Vol. 9, No. 1: An Apparently Unrecognized Race of Redwing from Utah. By Louis B. Bishop. Pp. 4. Vol. 9, No. 2: A New Race of Cliff Swallow from Northwestern Mexico. By A. J. van Rossem and the Marquess Hachisuka. Pp. 5–6. Vol. 9, No. 3: A Dimorphic Subspecies of the Bush-Tit from Northwestern Mexico. By A. J. van Rossem and the Marquess Hachisuka. Pp. 7–8. Vol. 9, No. 4: Descriptions of Three New Birds from Western Mexico. By A. J. van Rossem. Pp. 9–12. Vol. 9, No. 5: A Colorado Desert Race of the Summer Tanager. By A. J. van Rossem. Pp. 13–14. Vol. 9, No. 6: *Megalonyx Millieri*, a New Pleistocene Ground Sloth from Southern California. By Gretchen M. Lyon. Pp. 15–30+1 plate. Vol. 9, No. 7: An Illustrated Note on the Mating and Egg-brooding Habits of the Two-spotted Octopus. By Denis L. Fox. Pp. 31–34+plate 2. Vol. 9, No. 8: A New Form of *Perognathus formosus* from the Mohave Desert Region of California. By Laurence M. Huey. Pp. 35–36. Vol. 9, No. 9: Bees collected on the California Islands in the Spring of 1938. By T. D. A. Cockerell. Pp. 37–38. (San Diego, Calif.: San Diego Society of Natural History.) [812

Catalogues, etc.

Dichloro-Indophenol Tablets (2:6-Dichlorophenol-Indophenol) for the Estimation of Vitamin C. Pp. 2. (London: The British Drug Houses, Ltd.)

X-Ray Apparatus: Totally Immersed Units. Pp. 16. (London: Cuthbert Andrews.)

Radiography and Clinical Photography. Vol. 2, No. 4. Pp. 61–76. (London: Kodak, Ltd.)

Wirtschaftsgeographie: Produktions-, Konsumtions-, Handels- und Verkehrsgeographie. (Antiquariatskatalog Nr. 726.) Pp. 178. (Leipzig: Gustav Fock, G.m.b.H.)

Catalogue of Important Works on Botany, Zoology, Palæontology, and a few works on Mineralogy, Astronomy, Mathematics, etc. (No. 26.) Pp. 16. (London: John H. Knowles.)

Marmite (Yeast Extract) in Medicine and Dietetics. New edition. Pp. 24. (London: The Marmite Food Extract Co., Ltd.)

The Metallurgical Progress and Science of Heat Treatment for all Materials. Pp. 8. (Wembley: R. M. Catterson-Smith.)

Mycologia, Pathologia Plantarum. (No. 96.) Pp. 28. (Den Haag: Antiquariaat Junk.)

Diary for 1939. Pp. 32+32+32 maps+Diary. (Bonnybridge: John G. Stein and Co., Ltd.)

Kunst und Kunstgewerbe: Zeitschriften, Sammelwerke, Bücher, Abhandlungen. (Antiquariatskatalog Nr. 727.) Pp. 186. (Leipzig: Gustav Fock, G.m.b.H.)